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SURFACE PRESSURE MEASUREMENTS ON A BOATTAILED PROJECTILE SHAPE AT TRANSONIC SPEEDS

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US ARMY ARMAMENT RESEARCH AND DEVELOPMENT COMMAND
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Measurements of wall static pressures on a model with and without a boattail are reported. The model shape is similar to that of M549 projectile geometry. Data were acquired at Mach numbers of 0.91, 0.94, 0.96, 0.98, 1.10, and 1.20; angles of attack of 0, 2, 4, 6, and 10 degrees; and circumferential positions around the model in 22.5 degree increments.

Some of the pressure data were integrated over the model to provide axial force and static stability coefficients. Results are presented in both

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20. ABSTRACT (Continued)

graphical and tabulated form and some comparisons are made with computational results.

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I. INTRODUCTION

A theoretical and experimental research program has been underway in the Launch and Flight Division of BRL in recent years to provide capability for predicting projectile aerodynamics. Earlier efforts were predominantly in the supersonic regime; but in recent years, efforts have been extended to the transonic regime. The direction of the predictive capability is generally toward the use of modern finite-difference computational techniques. The primary objective of the experimental program is to obtain data for comparison with computations. The secant-ogive-cylinder-boattail (SOCBT) configuration (Figure 1) was chosen because a substantial quantity of experimental and computational data already exist for this shape which is typical of modern, low drag shell. The shape has been simplified, with respect to conventional shell, by using a pointed nose and by eliminating the rotating band.

A limited quantity of pressure data were obtained in the Naval Surface Weapons Center (NSWC) Wind Tunnel at Mach 0.908[1]. This test program illustrated that pressure taps at additional longitudinal stations were needed to adequately define the pressure distribution. Also, because of the critical flow behavior in the vicinity of projectile boattail at transonic speeds, data were needed at other transonic Mach numbers. Several pressure taps were added to the model and test time was requested in the Langley Research Center (LRC) 8-foot Transonic Pressure Tunnel which was capable of providing the desired Mach numbers.

II. EXPERIMENT

The model geometry for the secant-ogive-cylinder-boattail (SOCBT) configuration is shown in Figure 1; the model has a 3-caliber secant-ogive, a 2-caliber cylinder, and a 1-caliber, 7° boattail. The secant-ogive-cylinder (SOC) model is identical except that the 7° boattail is replaced by a cylindrical section; the SOC is, therefore, a 3-caliber secant-ogive, 3-caliber cylinder model.

The model, as used in previous test programs, was instrumented with pressure taps at 10 longitudinal positions. Tests at Mach 0.908 in the Naval Surface Weapons Center, White Oak Laboratory, Tunnel No. 2[1] demonstrated the need for more pressure taps. For this reason, the number of pressure taps was increased to 15 for the SOCBT and to 13 for the SOC. Internal size limitations of the models mandated that several taps be offset from the main ray of taps as shown in Figure 2. The 22.5° offset was chosen because data were to be acquired in roll angle increments of 22.5°. Hence, data could effectively be obtained at 15 longitudinal stations for the SOCBT by combining results from subsequent roll positions.

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1. *Kayser, L.D., "Surface Pressure Measurements on a Projectile Shape at Mach 0.908", U.S. Army Ballistic Research Laboratory/ARRADCOM Memorandum Report ARBRL-MR-03079, February 1981. AD A098589.*

All pressure tubing was connected to one Scanivalve which was located aft of the model inside the large sting section (Figure 3). Since only one transducer was used with the Scanivalve, any bias errors in the measurement system should be nearly the same for all measurements. Thus, the pressure variations on the model are more accurately defined than if several transducers had been used, but the values of absolute pressure are not necessarily more accurate.

The tests were conducted in the Langley Research Center 8-foot Transonic Pressure Tunnel which has a Mach number range of 0 to 1.30. The test section is 2.16 × 2.16 m square with filleted corners and the top and bottom walls have four slots each as shown in Figure 3.

Initially, the test procedure was to pitch the model to a given angle of attack and then record data at roll positions of 0 to 180 degrees in 22.5° increments. This procedure was used to obtain a complete set of data for the SOCBT configuration. Due to a failure in the roll mechanism, a slightly different procedure was used for acquiring data on the SOC configuration. Two sections of the sting were mated with a serrated facing having serrations at 22.5° increments. Therefore, each roll position change required tunnel shutdown and manually rolling the model. For this reason, as much data as possible was acquired at each roll position. Data, for a fixed roll position, were acquired at both positive and negative angles of attack and at all Mach numbers. Because of symmetry this procedure required roll angles from 0 to 90 degrees to define a complete pressure distribution; for example, ($\alpha = -4$, $\phi = 22.5$) ≡ ($\alpha = +4$, $\phi = 157.5$), etc. A complete set of data for the SOC was not acquired, primarily, due to other priority demands for power. The SOC measurements were more than 95% completed. The roll orientation, as shown in Figure 2, is not standard wind tunnel notation; the reason for this is that the data are to be used primarily for comparison to computational results where zero roll angle is defined as the most windward ray and positive roll is clockwise when looking at the base.

III. DATA PROCESSING

Since some of the pressure taps were offset from the main ray of taps by 22.5°, elements of the data array contained pressure at two roll angles. Appropriate adjustments were made so that all longitudinal pressures in the element were physically located at the same roll position. Also, since data are to be compared with computational values, the roll angle was shifted by 180° from the conventional wind tunnel coordinates: this defines zero degrees roll as the most windward ray when at angle of attack.

For the SOC model, data were acquired at both $\pm\alpha$ and at roll angles from 0 to 90 rather than 0 to 180. Because of symmetry, a data array could be generated for positive angles of attack and roll angles of 0 to 180 degrees. For example

$$[-\alpha, \phi] \equiv [+\alpha, 180-\phi]$$

It was desired to integrate some of the pressure data to obtain static aerodynamic coefficients, but it was believed that pressure measurements at 15 longitudinal positions and circumferentially in 22.5-degree increments did not provide a sufficient number of data points to obtain good results. For this reason, curve fitting of the data was performed and a larger data array was generated. Longitudinally, the model was divided into 0.05 caliber increments for a total of 120 increments. Circumferentially, the increment was chosen as 11.25° or 32 increments for the 360° interval. Circumferentially, it was determined that the additional points could be determined with sufficient accuracy by linear interpolation. Longitudinally, polynomial curve fitting was used with different polynomials for different segments of the model; some experimenting with the degree of polynomial and groupings of points was done before reasonable results could be consistently obtained. For comparison to the polynomial curve fit data, linear interpolation data, and extrapolation data at the end points, were generated. Static aerodynamic coefficients thus obtained did not differ by more than 3%. Since the polynomial curve fitting appeared to produce more realistic pressure distribution, only the aerodynamic data obtained from the polynomial curve fitting is presented.

The following equations were used to determine the three static aerodynamic coefficient for the SOCBT configuration. Pressures were not integrated over the SOC configuration at Mach 1.20 due to the lack of a complete set of data.

$$C_A = \frac{1}{S} \sum_{m=1}^{32} \sum_{n=1}^{120} C_{p_{m,n}} (\sin\theta_n)\, A_{m,n}$$

$$C_N = \frac{1}{S} \sum_{m=1}^{32} \sum_{n=1}^{120} C_{p_{m,n}} \cos\theta_n \cos\phi_m \, A_{m,n}$$

$$C_m = \frac{1}{D} \sum_{m=1}^{32} \sum_{n=1}^{120} C_{N_{m,n}} (Z_{cg} - Z_n) - C_{A_{m,n}} r_n \cos\phi_m$$

IV. RESULTS

Data are presented in both tabulated and graphical form. Tables 1-5 consist of a complete set of tabulated pressure data in the form of pressure coefficients. Figures 4 through 15 are graphical presentations of the pressure data or static stability data obtained from integration of the pressure data. Not all of the data are presented in graphical form, but enough is presented to illustrate the type and quality of data. Some comparisons of computational and experimental data are made which illustrate how the experimental data can be used to evaluate computational techniques. While some differences between experiment and computation are pointed out, this report is not intended to give an evaluation of computational techniques.

Figures 4a to 4d are longitudinal pressure distributions on the SOC configuration at zero angle of attack. The experimental data are compared with an inviscid computation which is a numerical solution of the transonic small disturbance equation for slender bodies[2]. Agreement is generally good on the ogival nose but at some transonic speeds, discrepancies occur on the cylindrical section (see figure 4b). Figures 4 a,b show a sharp expansion at the ogive-cylinder junction and then, within a short distance, a sharp recompression occurs indicating that a shock wave may exist. This recompression is seen to move downstream with increasing Mach number. Figures 5a and 5b are shadowgraphs of the SOC and verify that the shock wave exists and shows a dramatic movement for the Mach number range of 0.91 to 0.98.

Figures 6a to 6d are longitudinal pressure distributions on the SOC at 4 degrees angle of attack. Again, the inviscid computations show good agreement with experiment on the ogive, but not necessarily on the cylinder. The windward and leeward pressures, for both experiment and computation, show relatively small differences on the cylinder indicating that the nose contributes the dominant aerodynamic forces for this shape, but it will be shown later that the forces on the cylinder are not insignificant.

Figures 7a-7f are longitudinal pressure distributions at zero angle of attack for the SOCBT configuration. These figures show the dramatic expansion and recompression on the boattail. These data are compared to two types of computations: (1) the inviscid computation of Reference 2; (2) a numerical solution of the Thin Layer Navier-Stokes equations described in Reference 3. At Mach 0.91 (Figure 7a) it appears that both computations agree about equally well, but at higher subsonic Mach numbers (Figures 4 c,d) the Navier-Stokes solution clearly agrees much better with the experimental data.

Figures 8a-8f are longitudinal pressure distributions at 4 degrees angle of attack for the SOCBT configuration. The data are compared with the inviscid computation, but no corresponding Navier-Stokes computations were made. The reason that Navier-Stokes computations were not made is that angle of attack requires fully three-dimensional calculations, and the allowable number of mesh points, because of computer limitations, is not sufficient to provide the desired accuracy; the zero-angle of attack computations are two-dimensional and, as illustrated in Figures 7a-7e, can be performed with good accuracy. The angle of attack data show substantial pressure differences on the nose between the windward and leeward sides; on the cylinder, pressure differences are small and; on the boattail, pressure differences are

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2. *Reklis, R.P., Sturek, W.B., and Bailey, F.R., "Computations of Transonic Flow Past Projectiles at Angle of Attack," AIAA Paper No. 78-1182, presented at the AIAA 11th Fluid and Plasma Dynamics Conference, Seattle, Washington, July 1978.*

3. *Nietubicz, C.J., "Navier-Stokes Computations for Conventional and Hollow Projectile Shapes at Transonic Velocities," AIAA Paper No. 81-1262 presented at the AIAA 14th Fluid and Plasma Dynamics Conference, Palo Alto, California, July 1981.*

moderate. On the boattail, agreement between experiment and computation is fairly good, but the computations generally show a greater difference between windward and leeward pressures. This greater difference is probably due to the fact that the computation does not include the boundary layer effect. At positive angle of attack, the boattail force is negative, and this negative force, acting aft of a typical c.g., produces a positive pitching moment. Thus, the computational difference on the boattail would yield a smaller total normal force and a larger pitching moment.

Figure 9 is the longitudinal pressure distribution at 10 degrees angle of attack. The agreement between computation and experiment at this large angle of attack is qualitatively good, but sufficient differences do exist so that aerodynamic forces obtained from the inviscid computation are not expected to have good accuracy. The sharp pressure rise on the boattail indicates asymmetry of the boattail shock from the windward to the leeward side of the model. The shock wave asymmetries can be seen on the Mach 0.96 shadowgraphs of Figures 10 a,b. The asymmetry is most noticeable at the higher angles of attack of 4 and 6 degrees shown in Figure 10b.

Circumferential pressure distributions are shown at three longitudinal stations of the SOCBT configuration at Mach 0.96 in Figures 11a-11c. Figure 11a shows that ogive pressures on the windward side are greater than those on the leeward side, thus providing a positive normal force contribution. On the cylinder, Figure 11b, pressures are seen to be nearly symmetrical about the 90 degree position which indicates small contribution to normal force for the longitudinal position of Z/D = 4.22. On the boattail (Figure 11c), pressures on the windward ray are smaller than on the leeward ray indicating a negative normal force contribution. The negative boattail force would be aft of a typical center of gravity location and; therefore, contribute to a destabilizing pitching moment. These same phenomena can be deduced from the longitudinal pressure distributions at angle of attack, Figures 8a-8f, but the circumferential pressure distributions provide a different perspective. Figures 12-15 are axial force and static stability data obtained from integration of pressures over the model. Figure 12 compares zero angle of attack axial force from experiment and two types of computations for the SOCBT. The axial force consists of the ogive nose contribution and boattail contribution, but base drag was assumed to be zero for all cases. The agreement is very good in the Mach number range of 0.91 to 0.98, but at the low supersonic speeds small differences occur. Figure 13 shows the normal force and pitching moment coefficients at various angles of attack. These coefficients, C_N and C_m, show a critical behavior in the Mach number range of 0.94 to 0.98; they also show a consistent type of behavior at the different angles of attack. This consistency provides encouragement that the coefficients obtained by the integration of experimental pressure data provide reasonable results since there was concern that the number of pressure taps was not sufficient to deduce force and moment coefficient data.

Figure 14 compares values of C_{N_α} and C_{m_α} on SOC configurations. The agreement between the inviscid computation and experiment may be considered fair, but the inviscid computation does not seem to predict the critical behavior shown by the experiment. C_{N_α} for the nose only is also shown. The

contribution from the cylinder is, therefore, the difference between the total value and the nose value. The inviscid computation shows a small normal force contribution from the cylinder whereas the experimental data indicate a significant normal force contribution from the cylinder and also a critical behavior in the Mach .94 to .96 range.

Figure 15 compares computational and experimental values of static stability data for the SOCBT configuration. The agreement is only fair, but the differences are qualitatively in the direction suggested above in the discussion of Figure 9; that is, the boattail pressure distributions indicated that the inviscid computation would show a smaller normal force and a greater pitching moment.

V. CONCLUSIONS

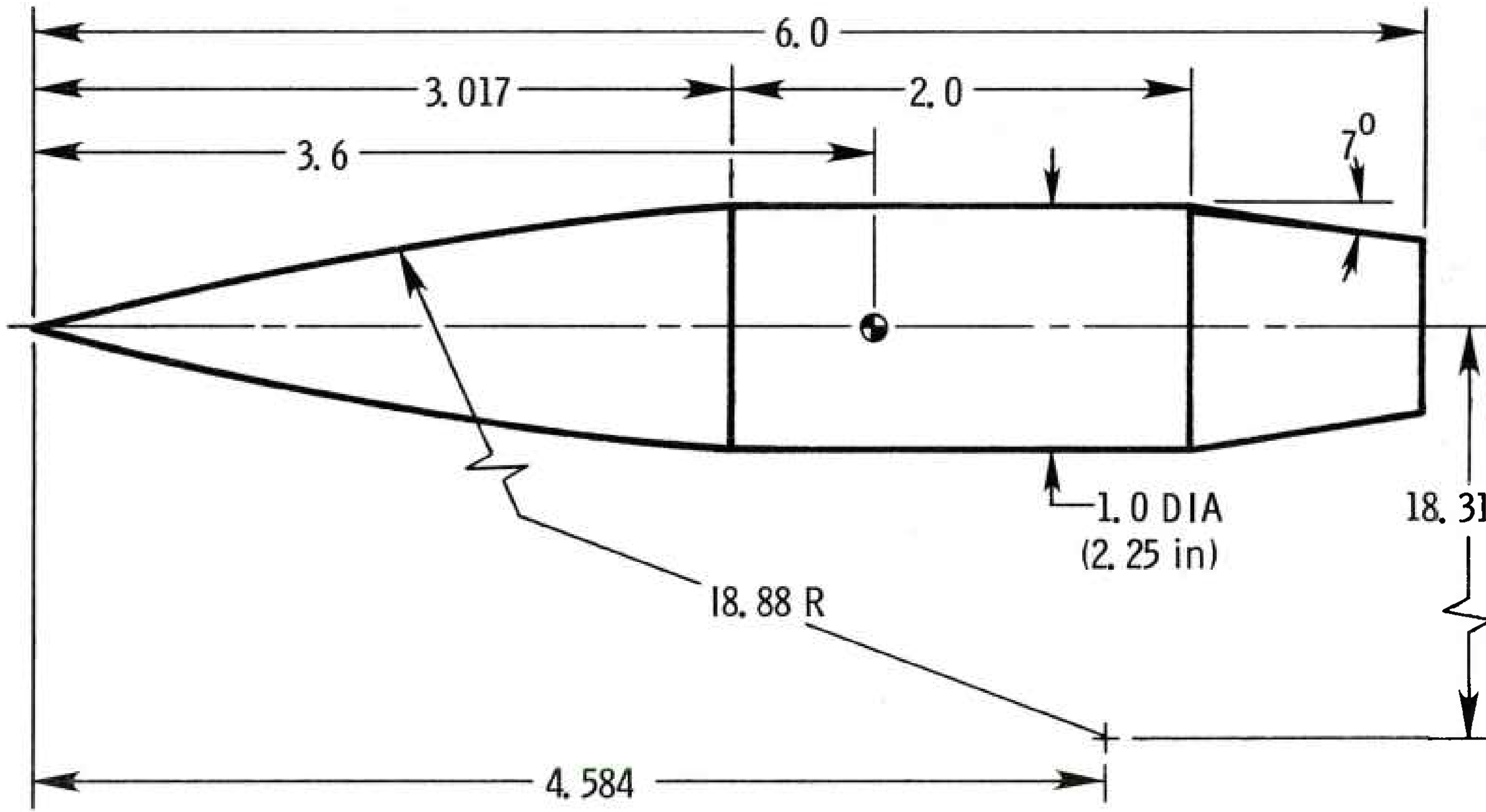
1. A comprehensive set of transonic pressure data have been obtained on a simplified projectile shape with and without a boattail at angles of attack up to 10 degrees.

2. Comparisons of experimental data for various parameters show a degree of consistency which indicates that the quality of the experimental pressure data is good.

3. The pressure data are of sufficient quality to obtain axial force and static stability coefficients by integration of the pressure data over the body.

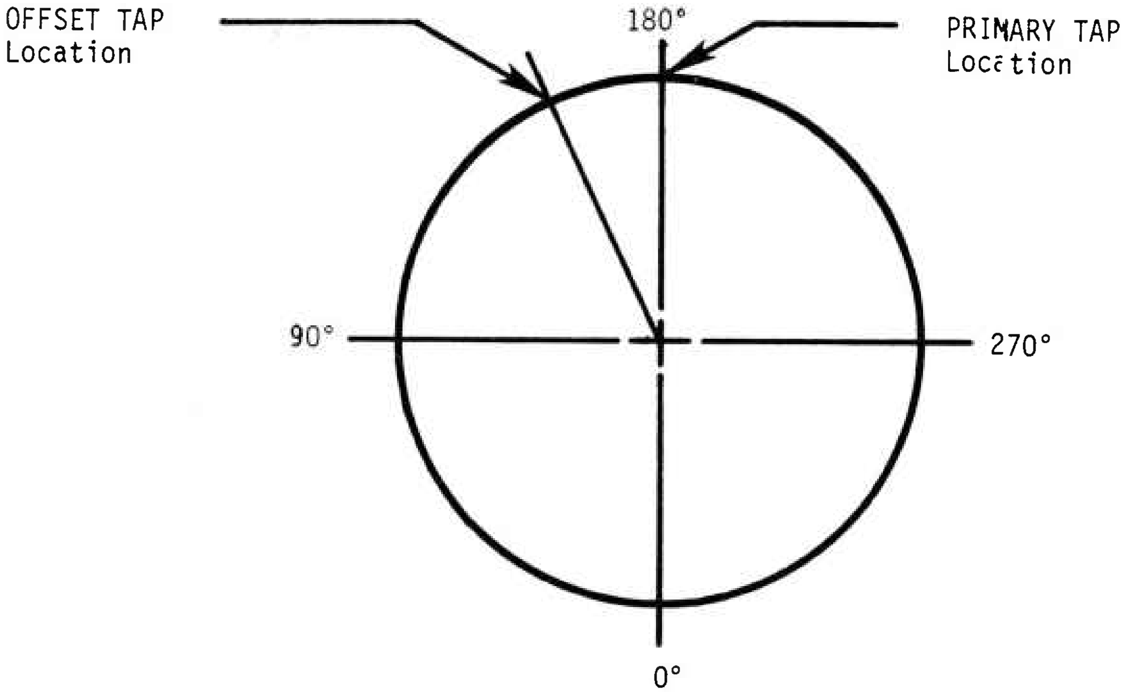
4. The comparisons between computation and experiment illustrate the application of these experimental data in evaluating computational techniques for predicting surface pressure on bodies of revolution in transonic flow. These comparisons indicate that significant discrepancies between computation and experiment are present and that the prediction of the static moment for boattailed shell at transonic velocities requires considerable additional effort.

SOCBT



ALL DIMENSIONS IN CALIBERS

Figure 1. Model Geometry - SOCBT



Base View

SOCBT

Tap	Z-in	Z/D	ϕ
1	2.00	.89	180
2	3.51	1.56	180
3	5.00	2.22	180
4	6.28	2.79	180
5	7.04	3.13	180
6	7.24	3.22	157.5
7	8.01	3.56	180
8	9.50	4.22	180
9	10.24	4.55	157.5
10	10.98	4.88	180
11	11.33	5.03	157.5
12	11.67	5.19	157.5
13	11.97	5.32	180
14	12.52	5.56	157.5
15	13.01	5.78	180

SOC

Tap	Z-in	Z/D	ϕ
1	2.00	.89	180
2	3.51	1.56	180
3	5.00	2.22	180
4	6.28	2.79	180
5	7.04	3.13	180
6	7.24	3.22	157.5
7	8.01	3.56	180
8	9.50	4.22	180
9	10.24	4.55	157.5
10	10.98	4.88	180
11	11.97	5.32	180
12	12.63	5.61	180
13	13.01	5.78	180

Figure 2. Pressure Tap Locations

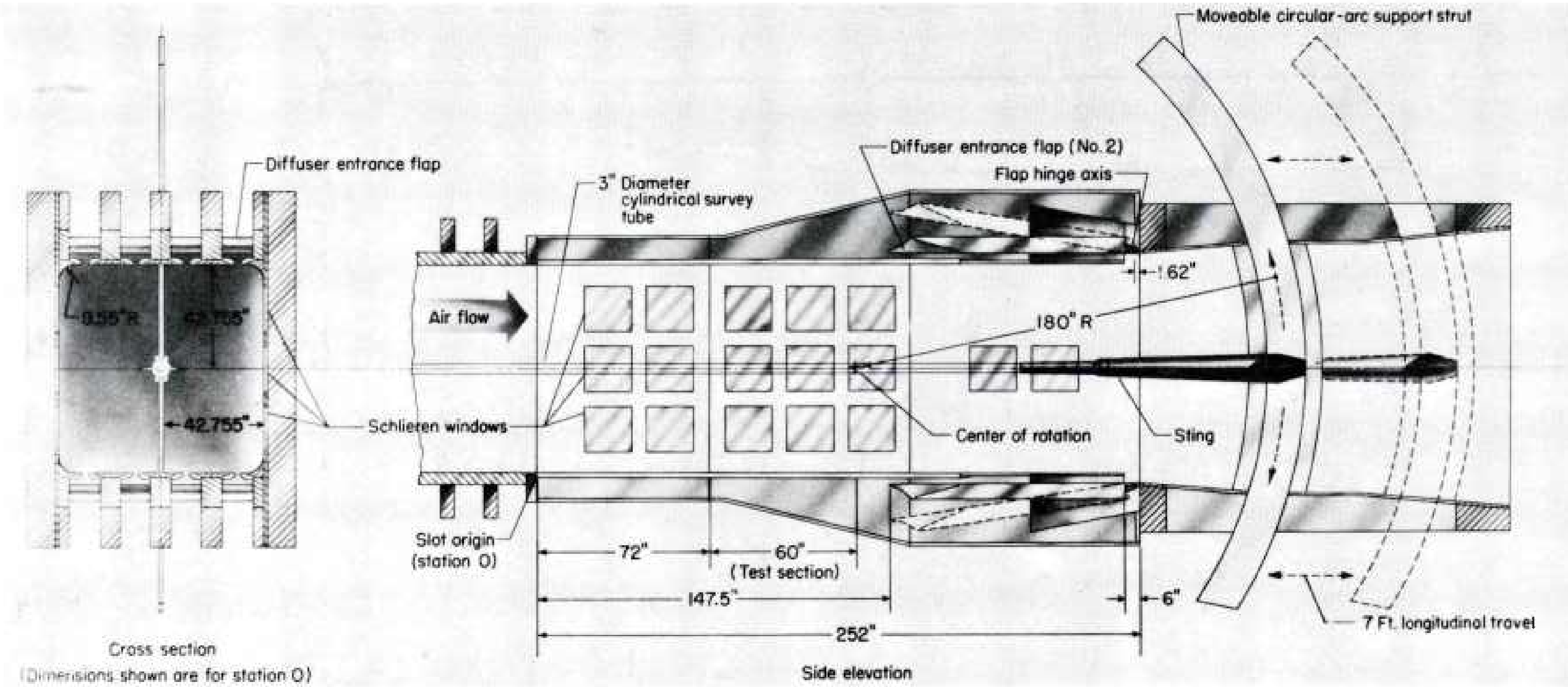


Figure 3. Slotted-Throat and Diffuser Regions of the Langley 8-foot Transonic Pressure Tunnel

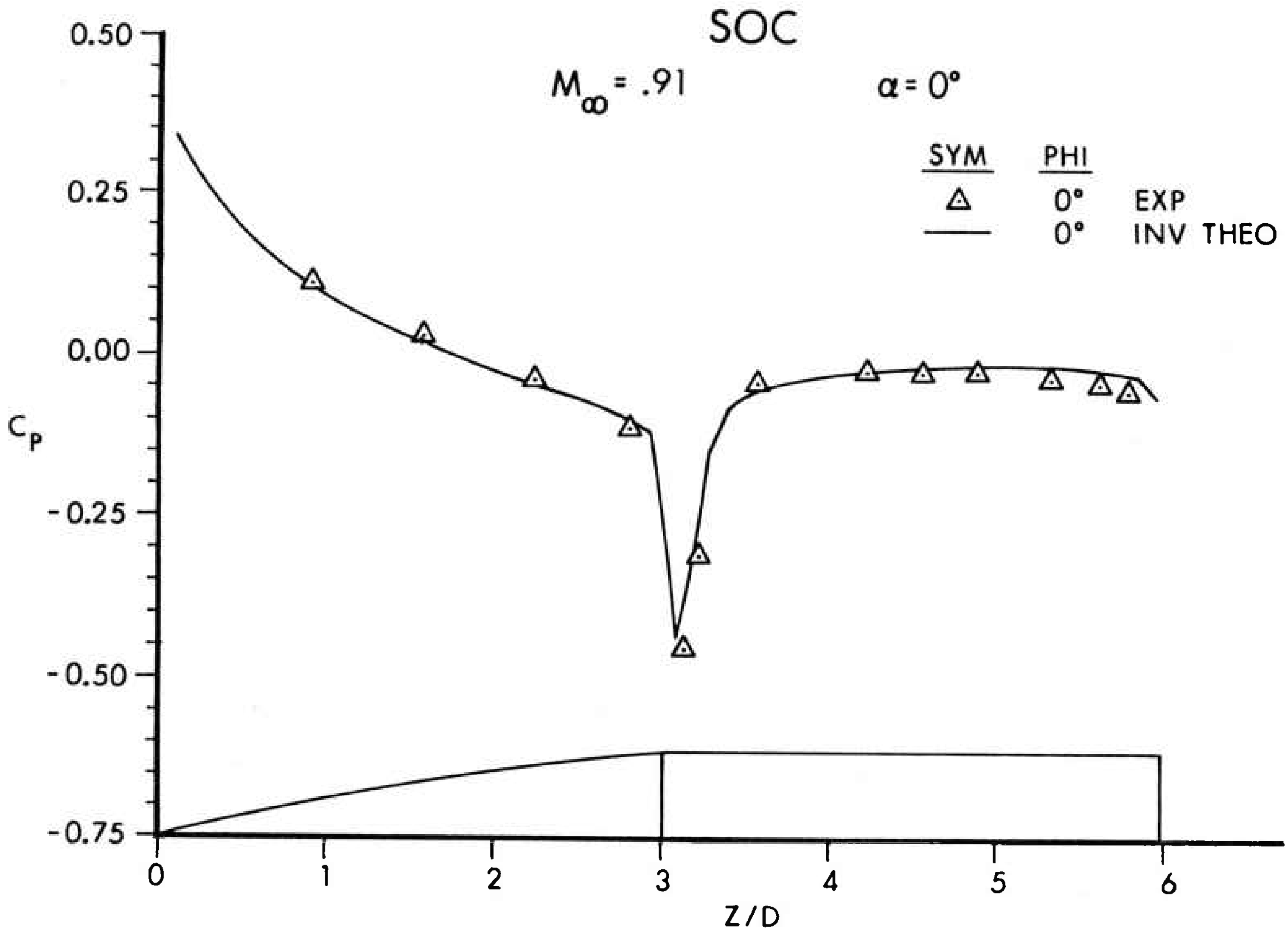


Figure 4. SOC Longitudinal Pressure Distributions, α = 0, Experiment and Theory

a. M_∞ = 0.91

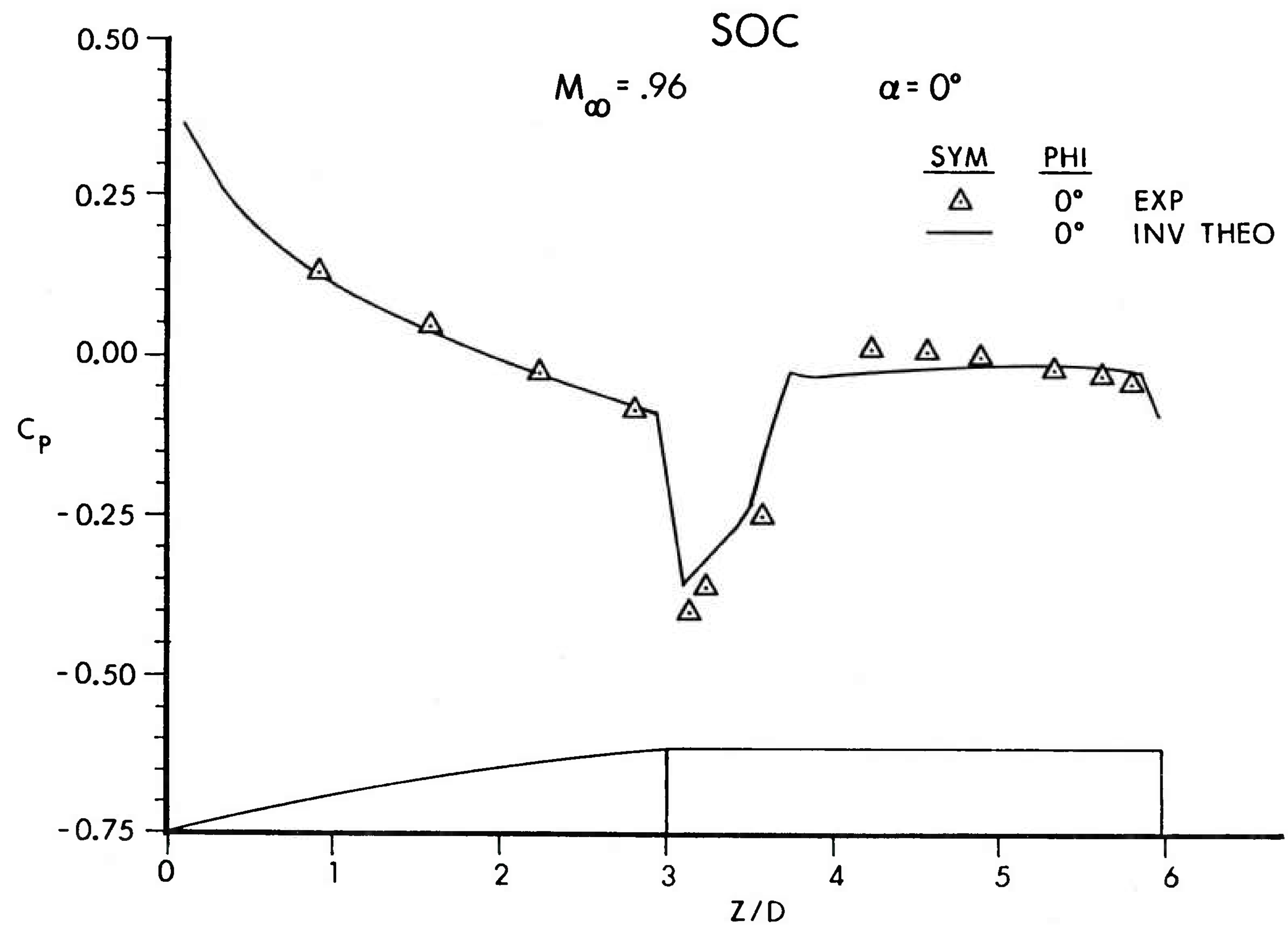


Figure 4b. $M_\infty = 0.96$

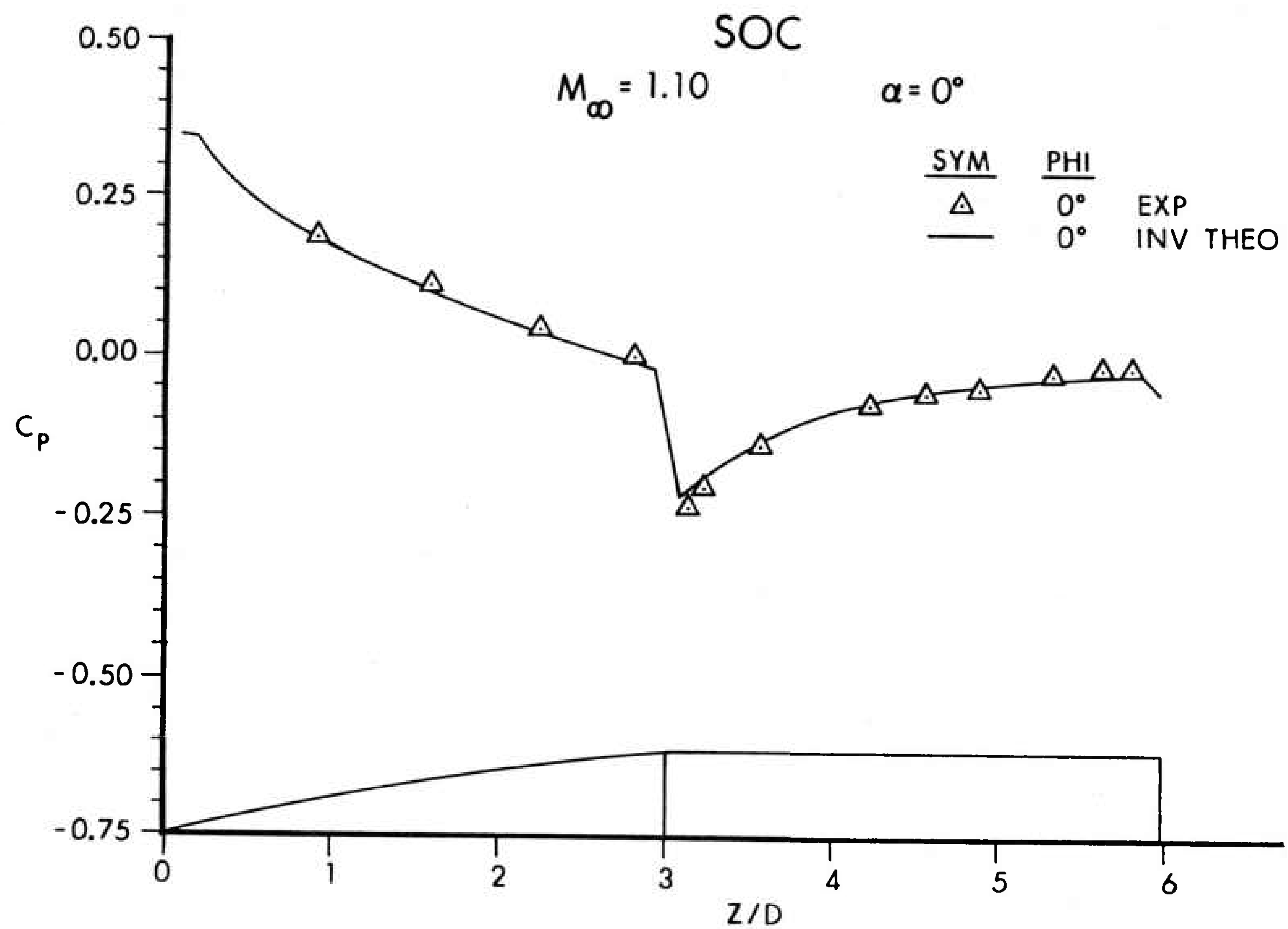


Figure 4c. $M_\infty = 1.10$

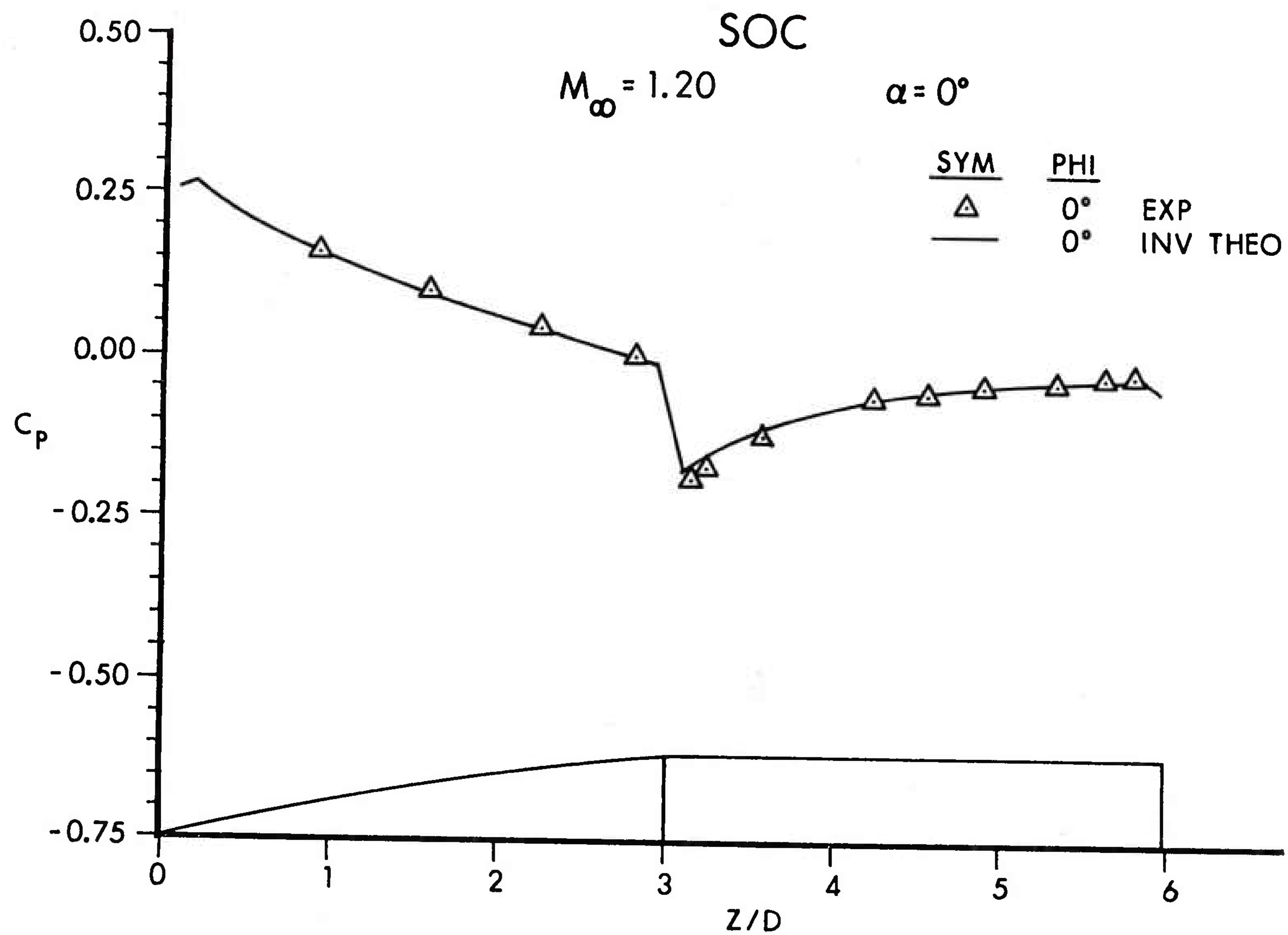


Figure 4d. M_∞ = 1.20

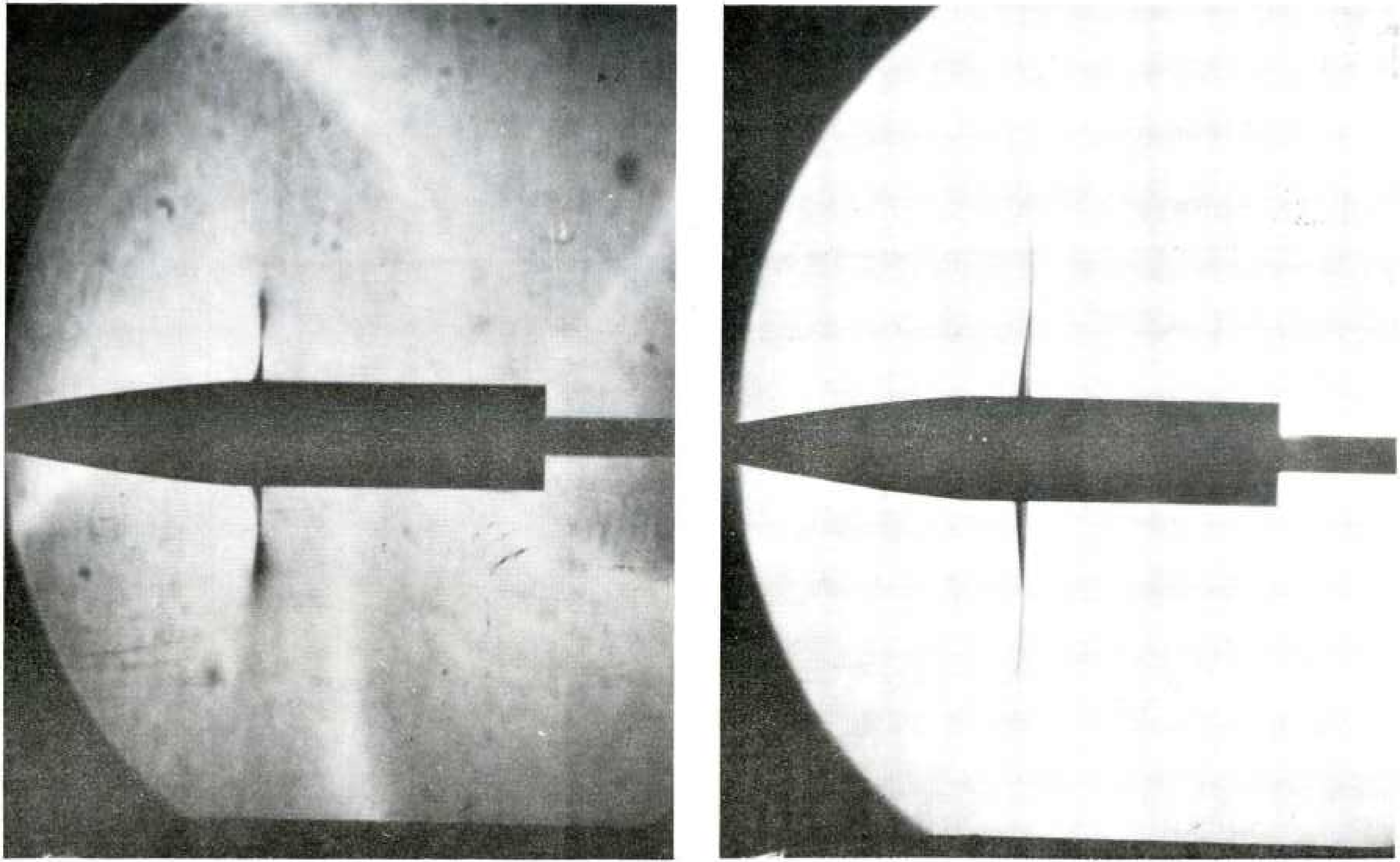


Figure 5. SOC Shadowgraphs, $\alpha = 0$

a. $M_\infty = 0.91, 0.94$

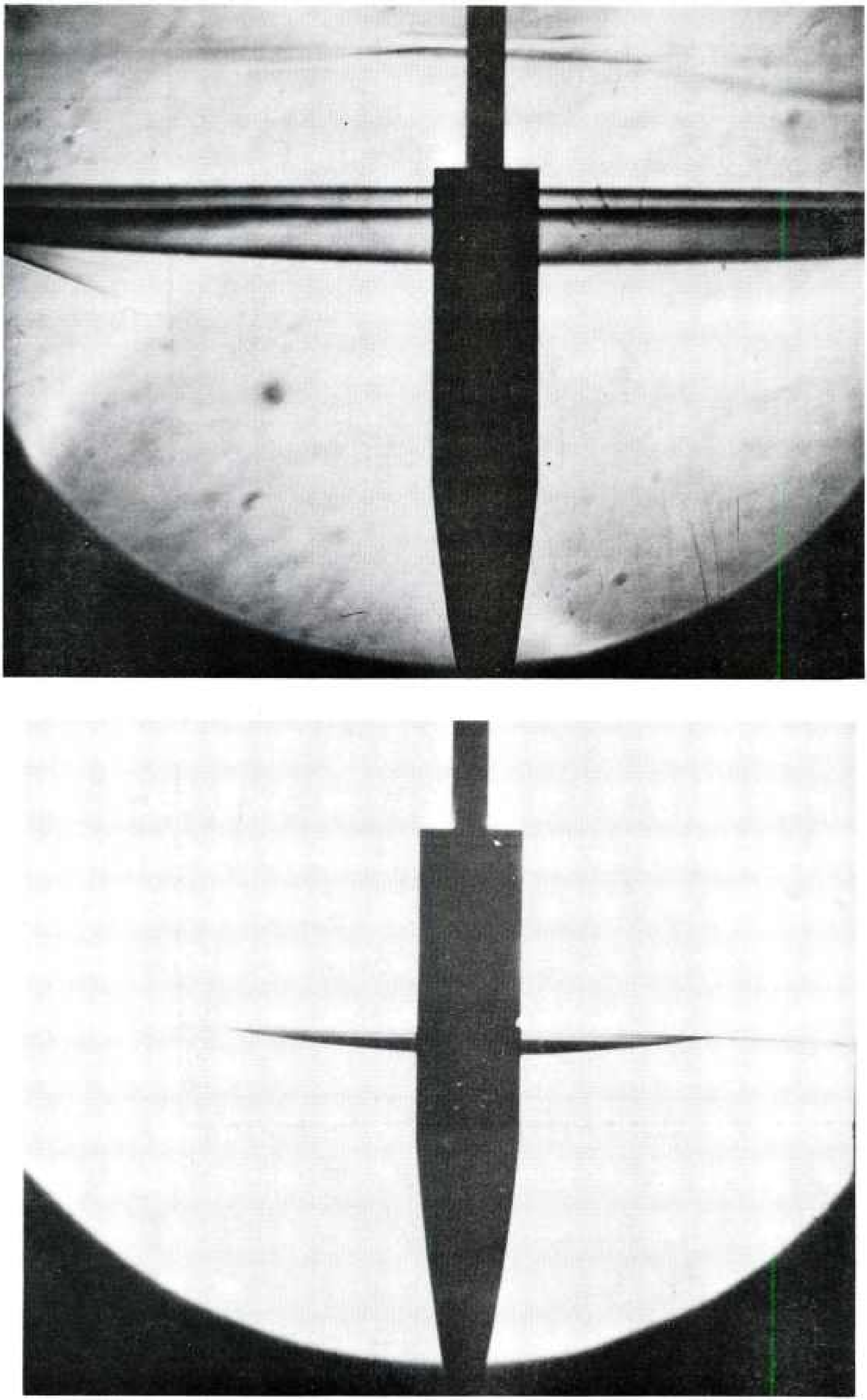


Figure 5b. M_∞ = 0.96, 0.98

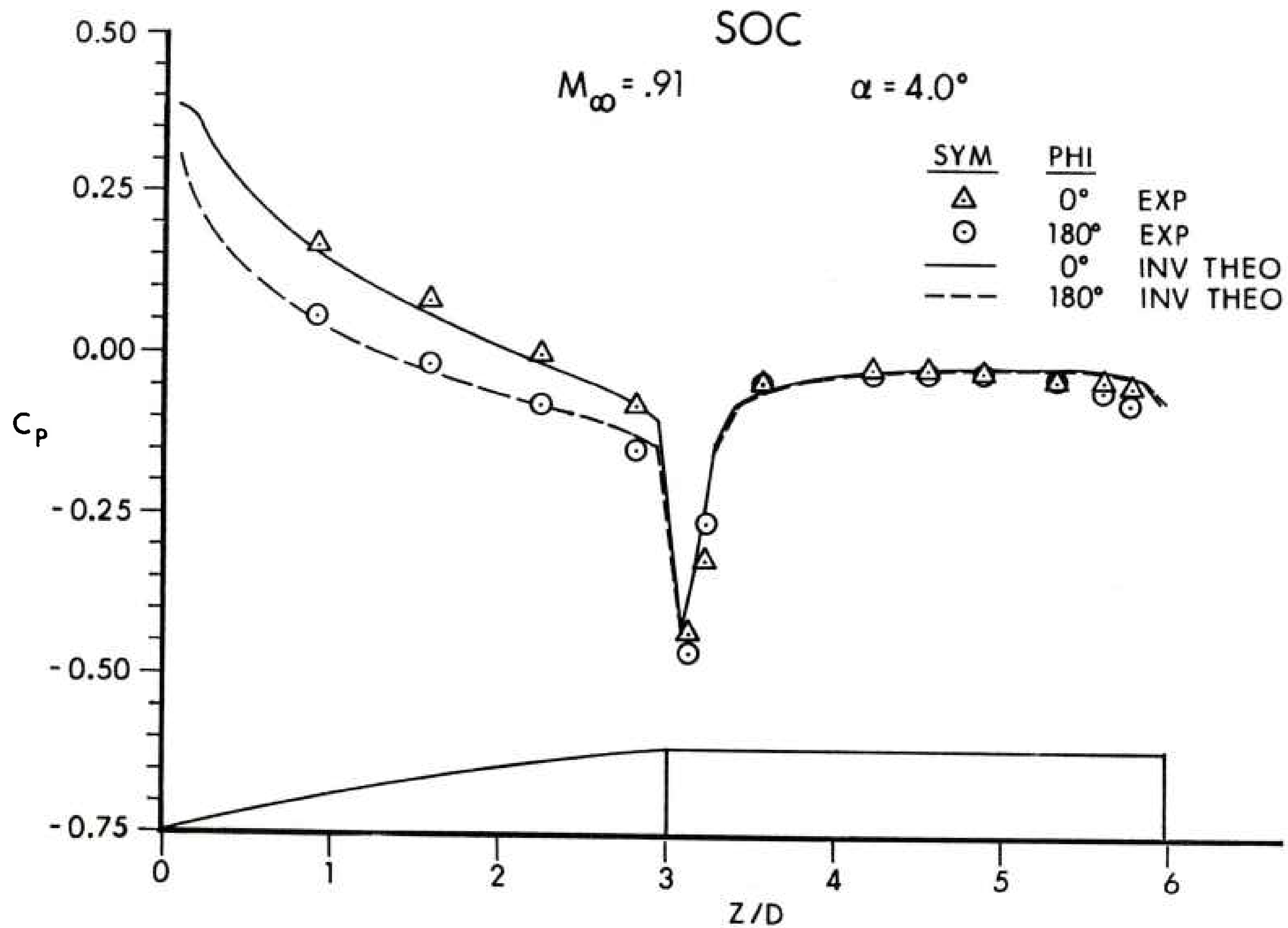


Figure 6. SOC Longitudinal Pressure Distributions, $\alpha = 4°$, Experiment and Theory

a. $M_\infty = 0.91$

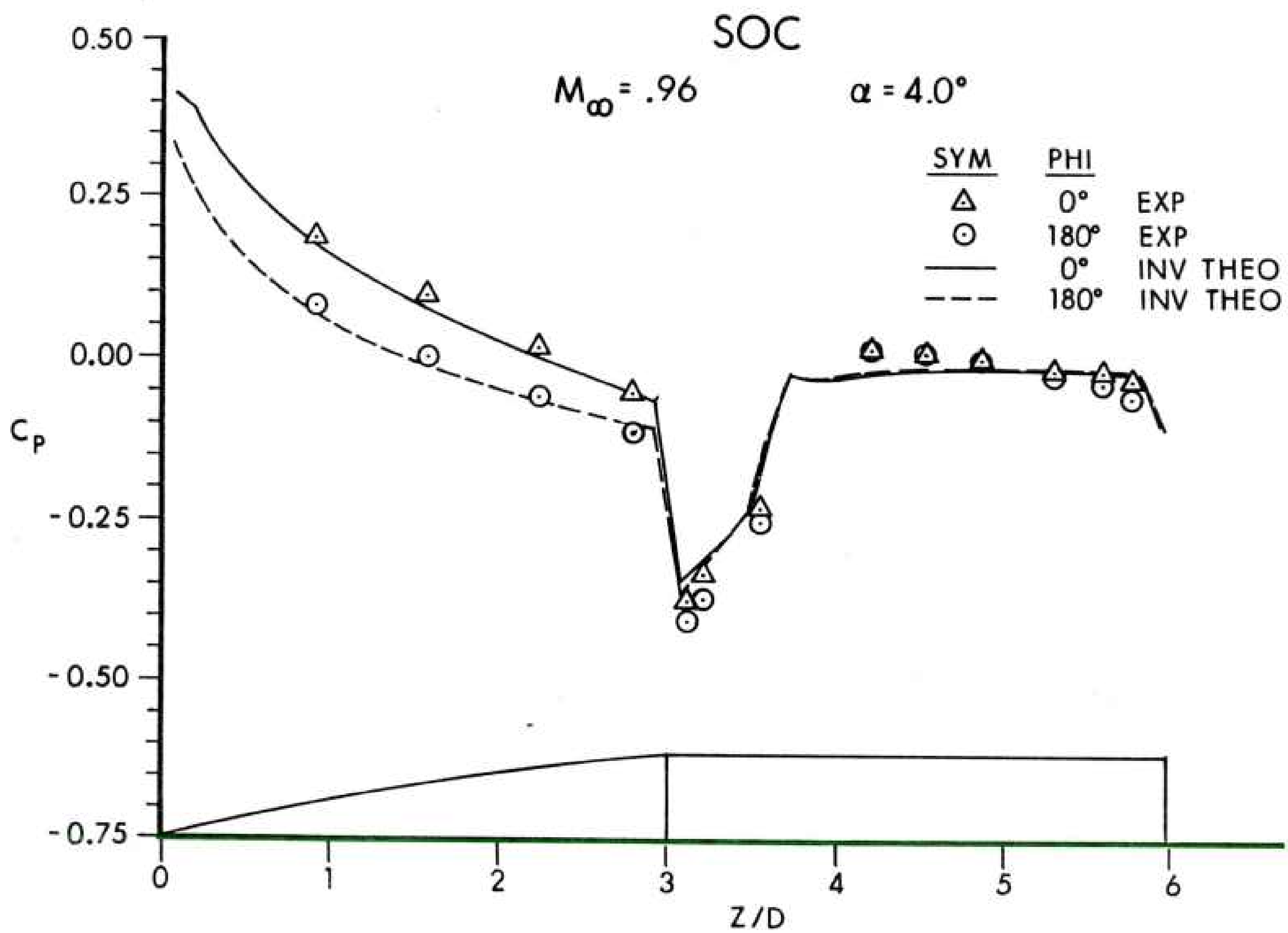


Figure 6b. $M_\infty = 0.96$

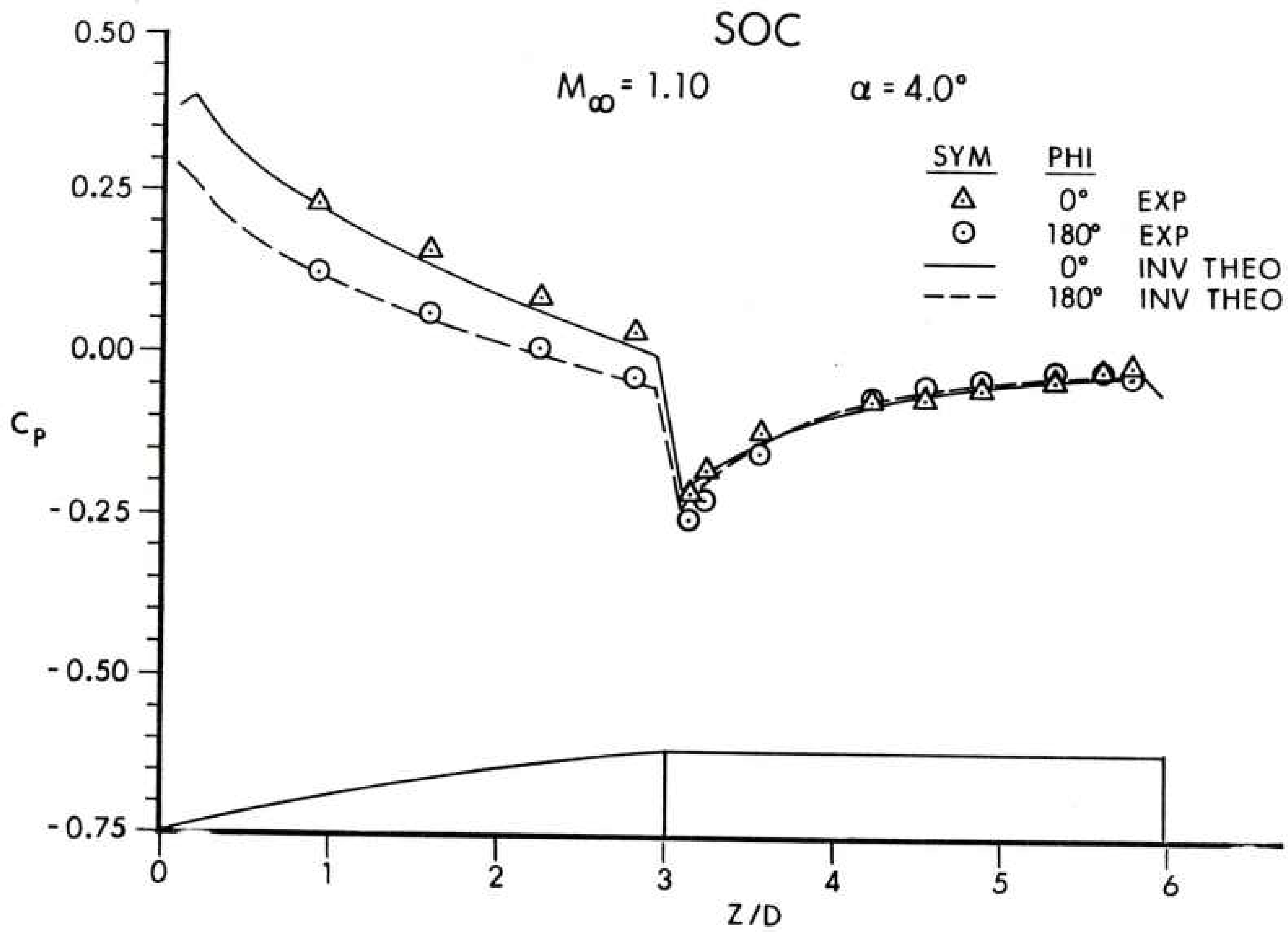


Figure 6c. M_∞ = 1.10

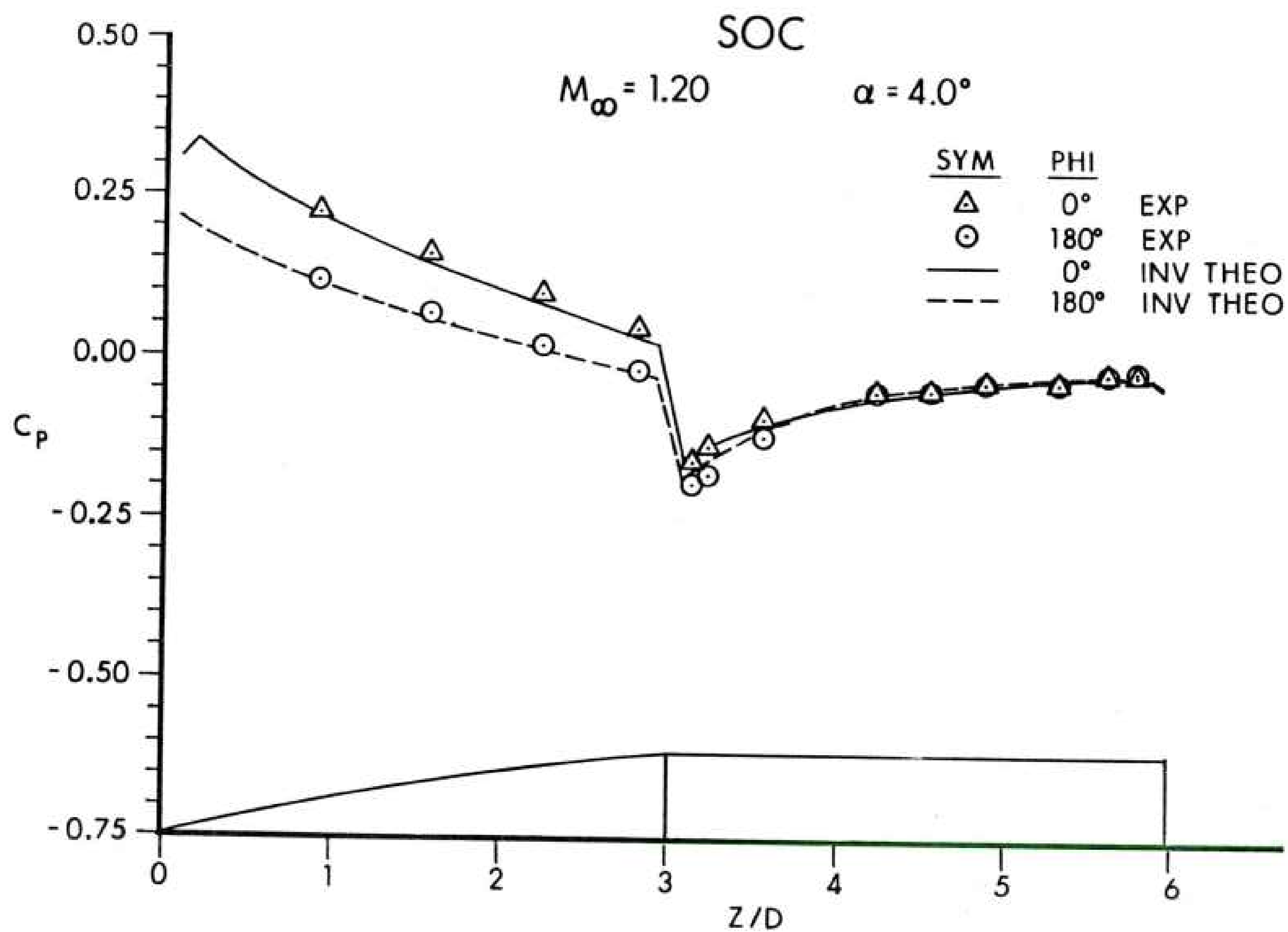


Figure 6d. M_∞ = 1.20

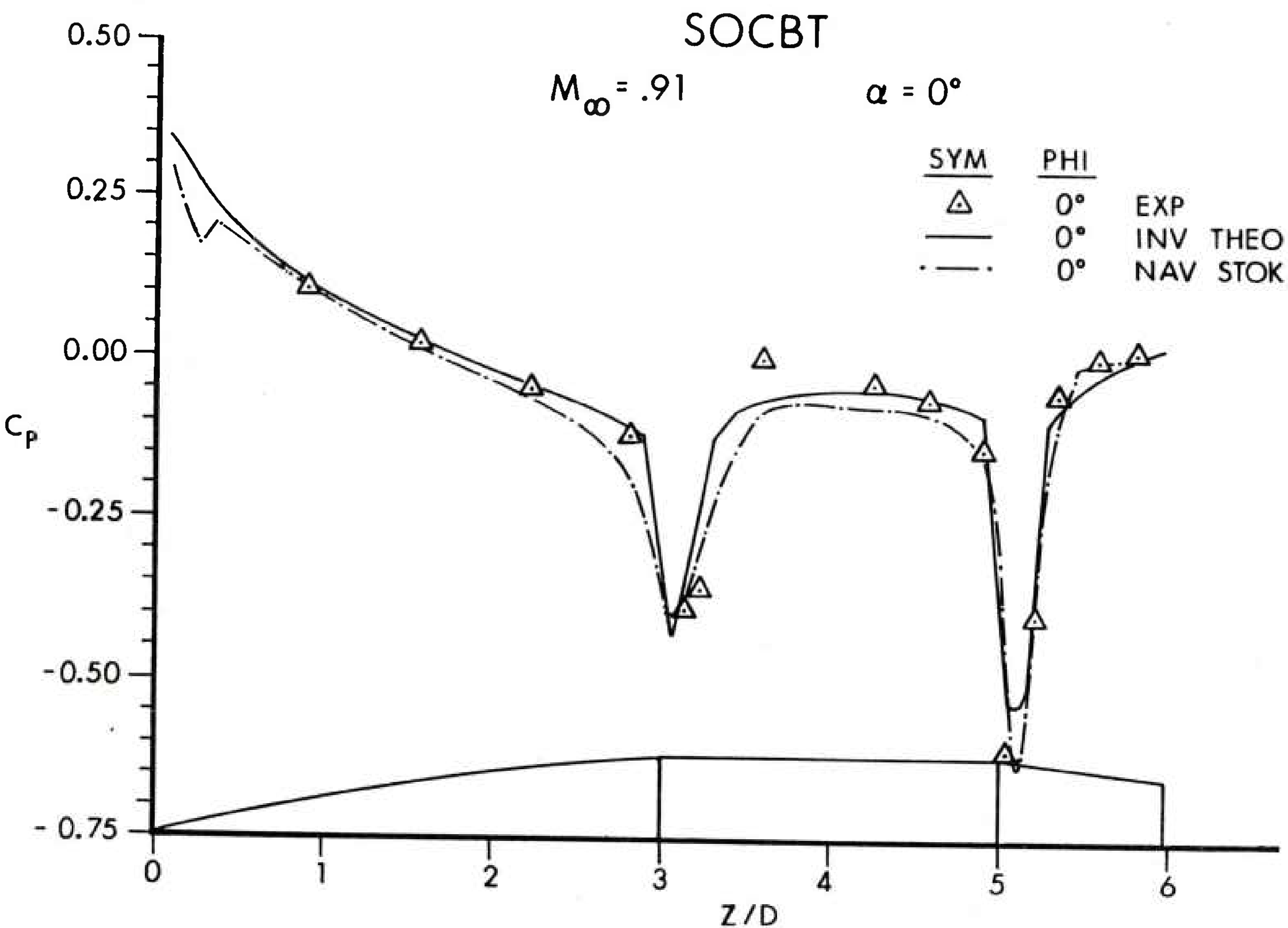


Figure 7. SOCBT Longitudinal Pressure Distributions, α = 0, Experiment and Theory

a. M_∞ = 0.91

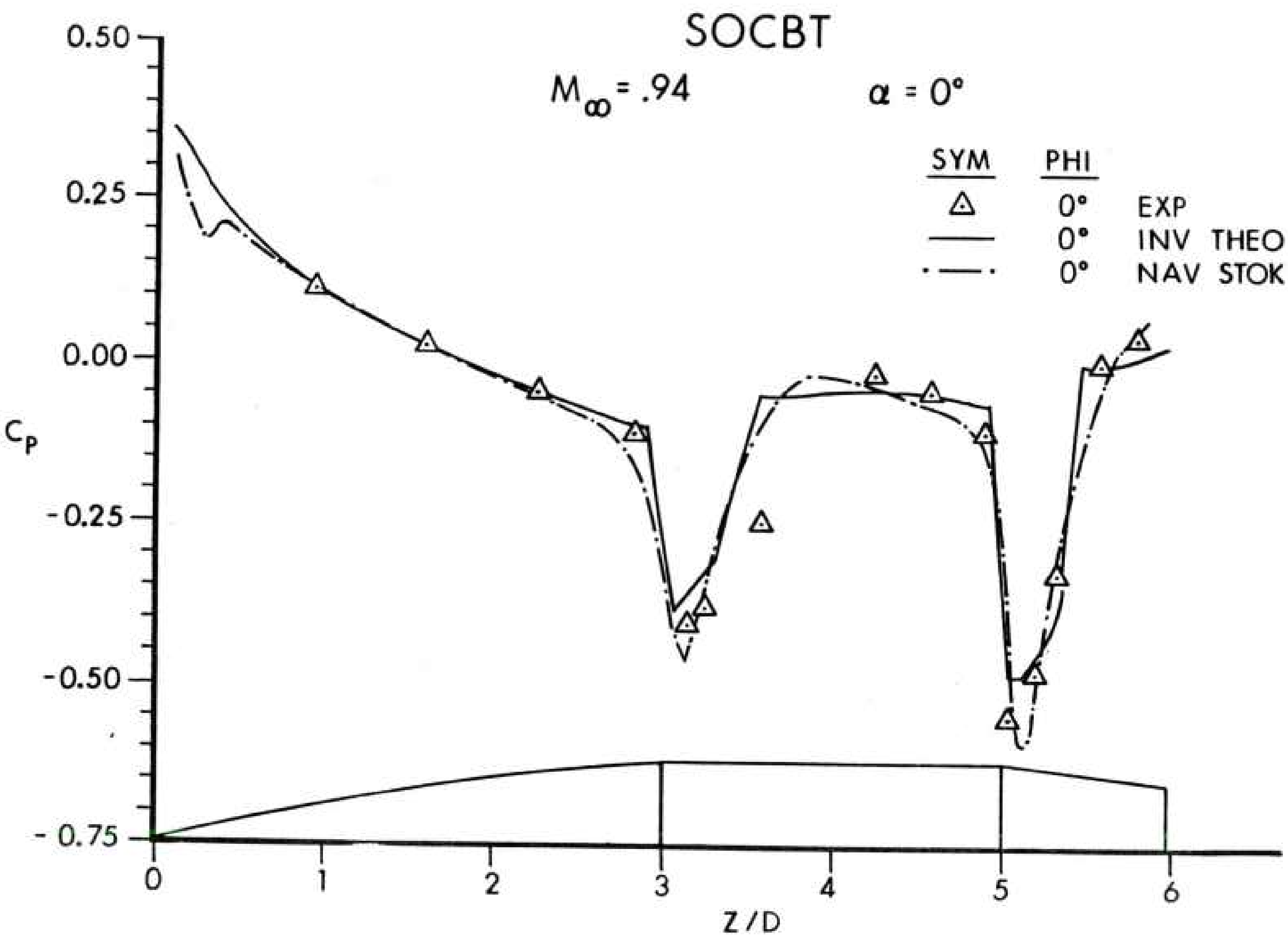


Figure 7b. $M_\infty = 0.94$

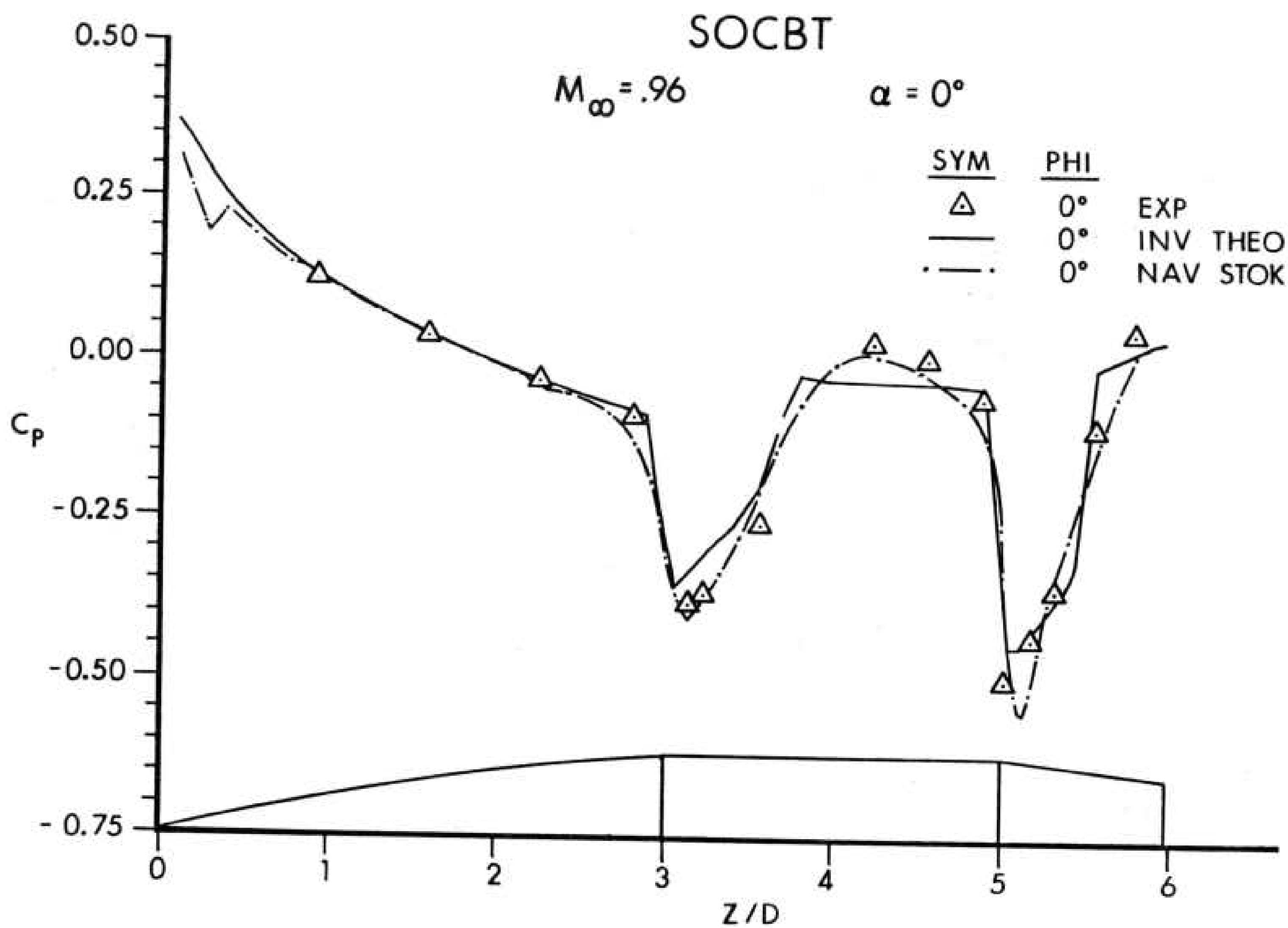


Figure 7c. $M_\infty = 0.96$

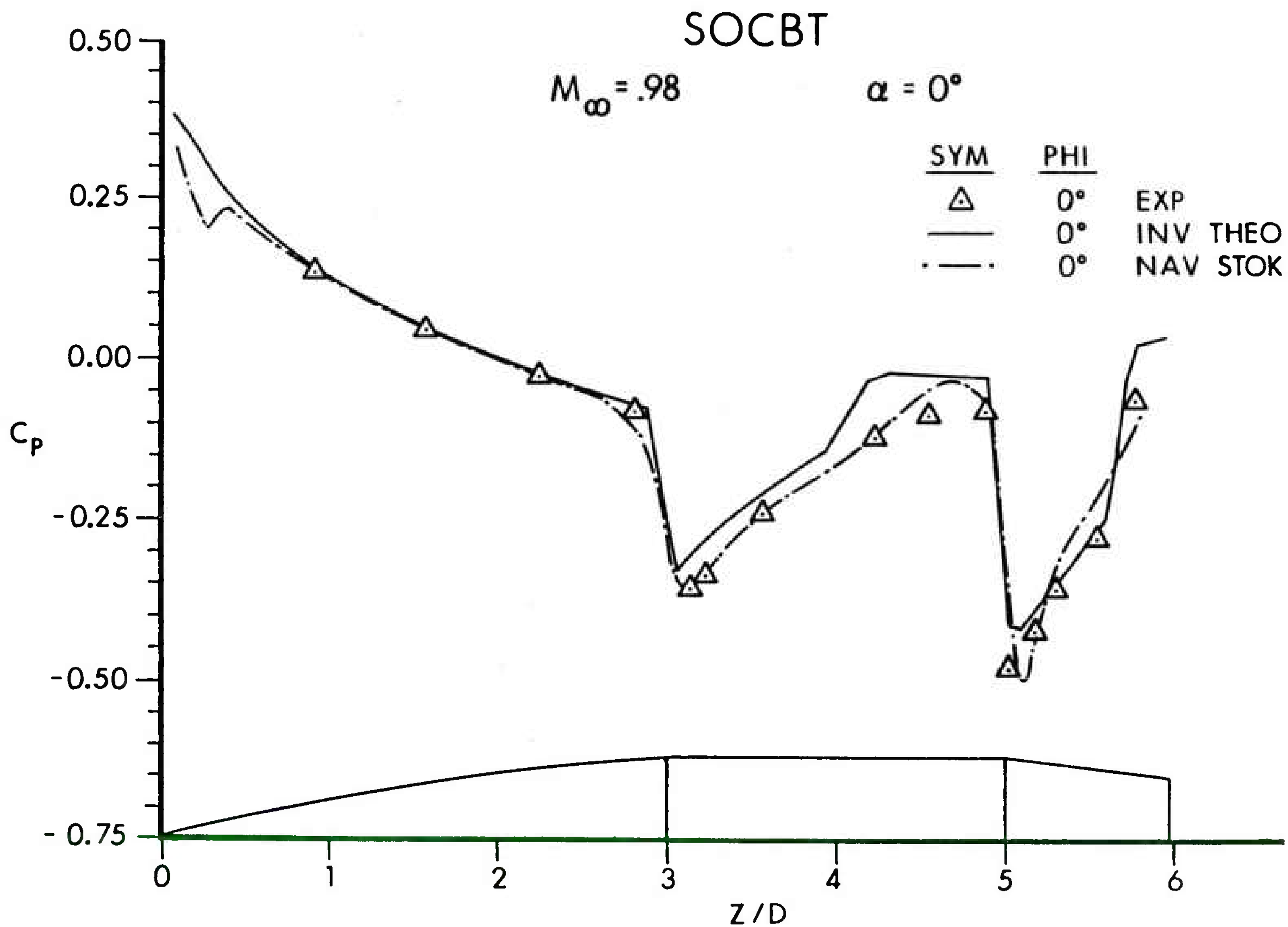


Figure 7d. $M_\infty = 0.98$

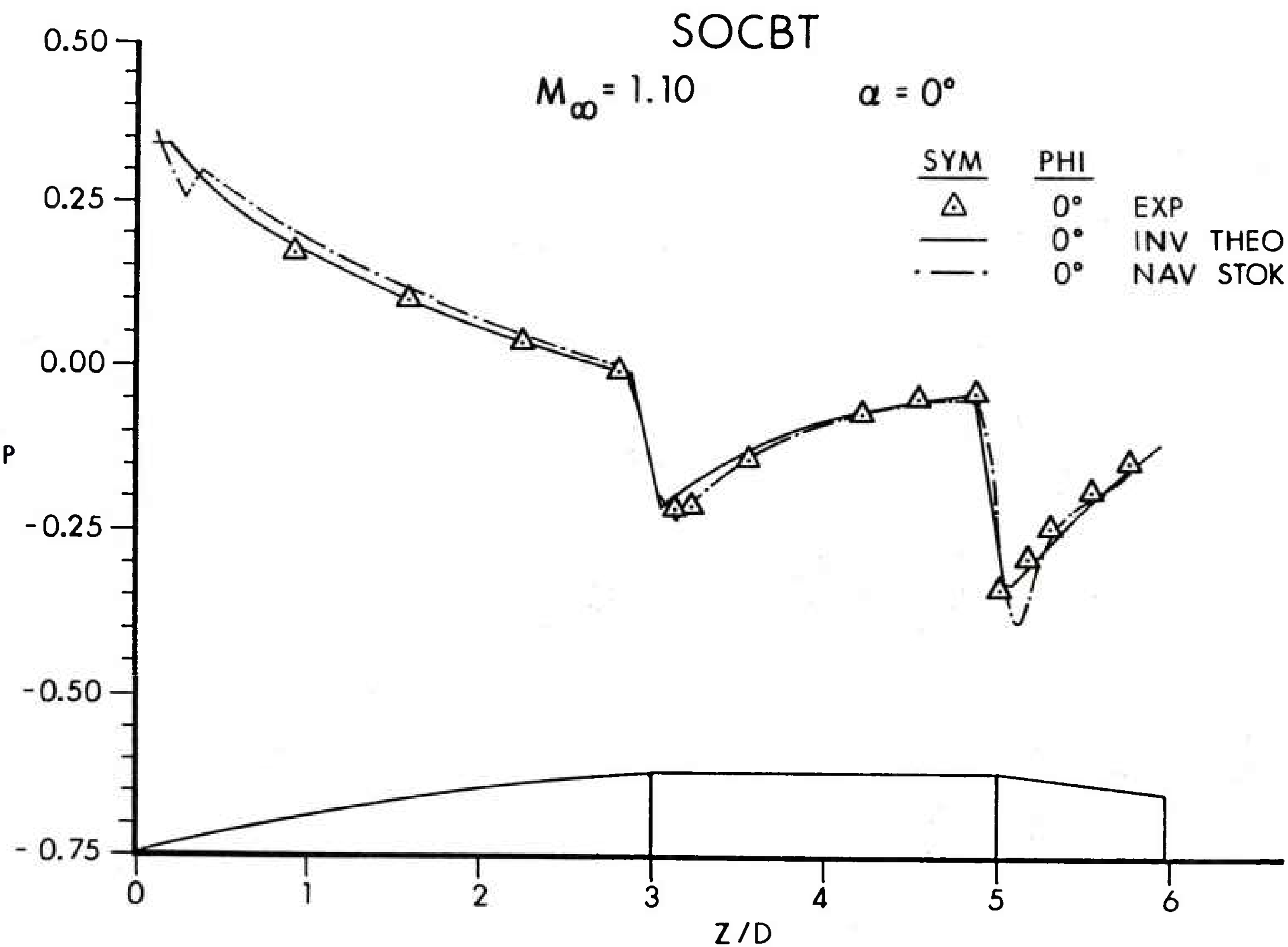


Figure 7e. $M_\infty = 1.10$

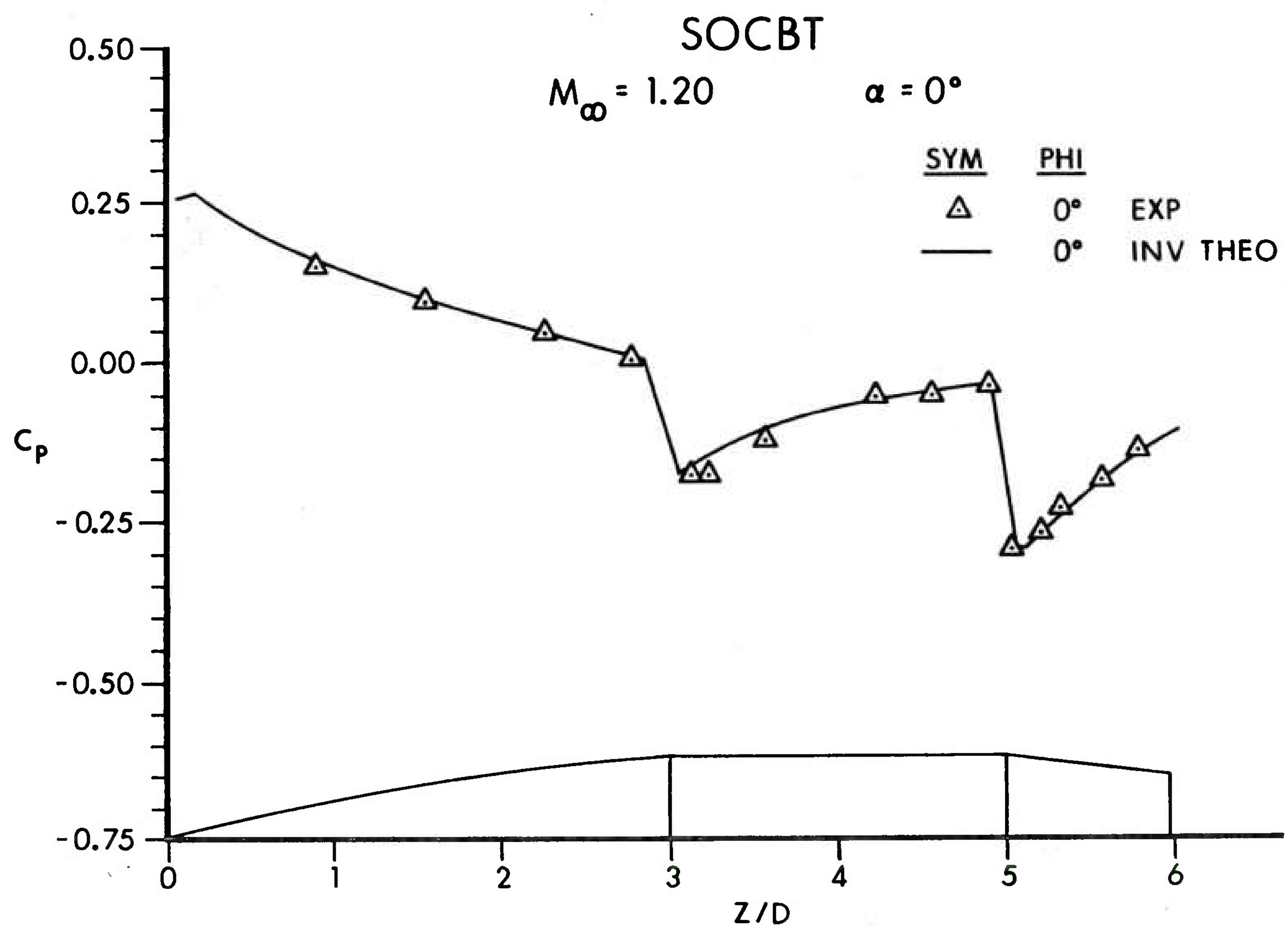


Figure 7f. M_∞ = 1.20

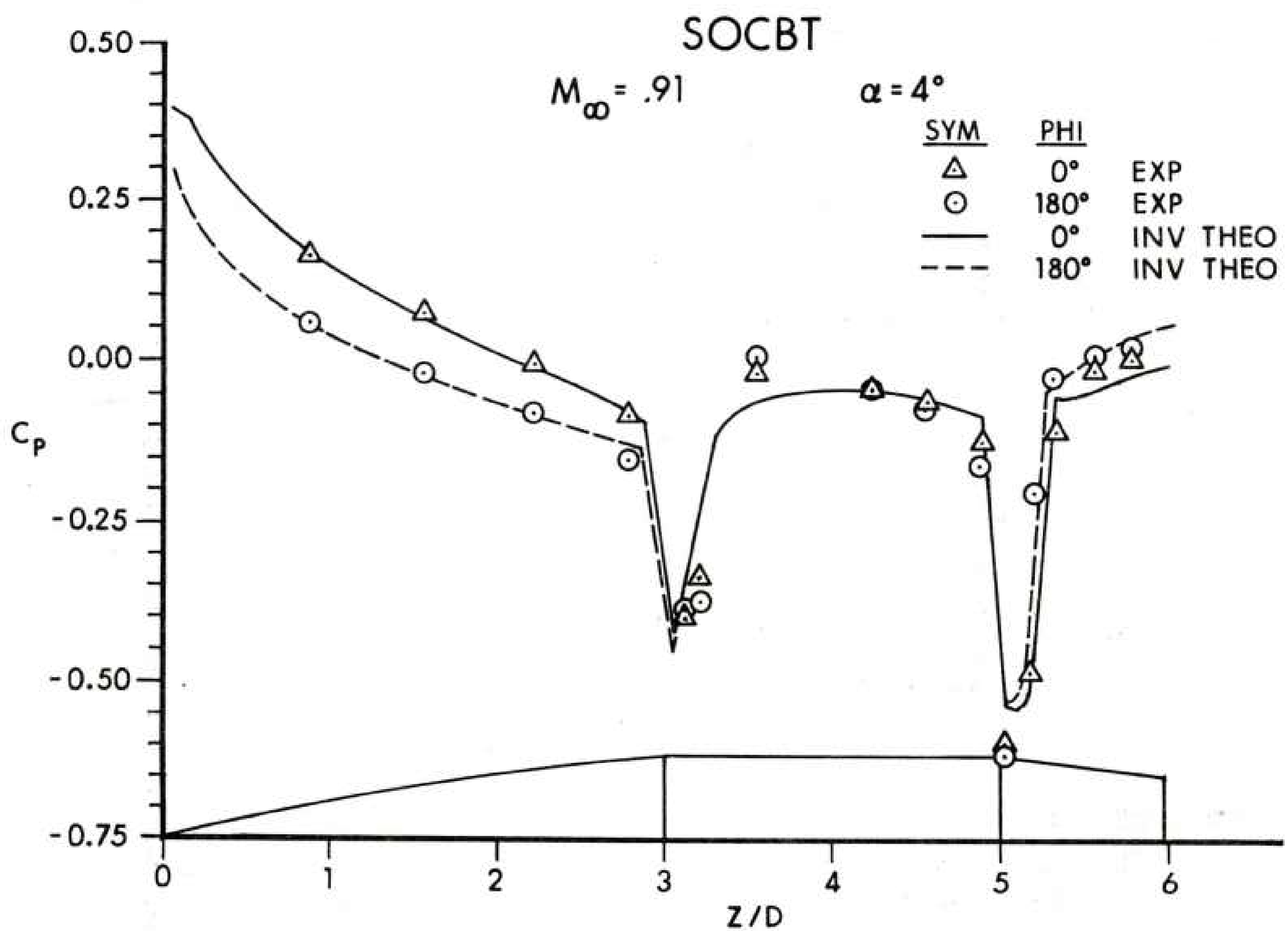


Figure 8. SOCBT Longitudinal Pressure Distributions, $\alpha = 4°$, Experiment and Theory

a. $M_\infty = 0.91$

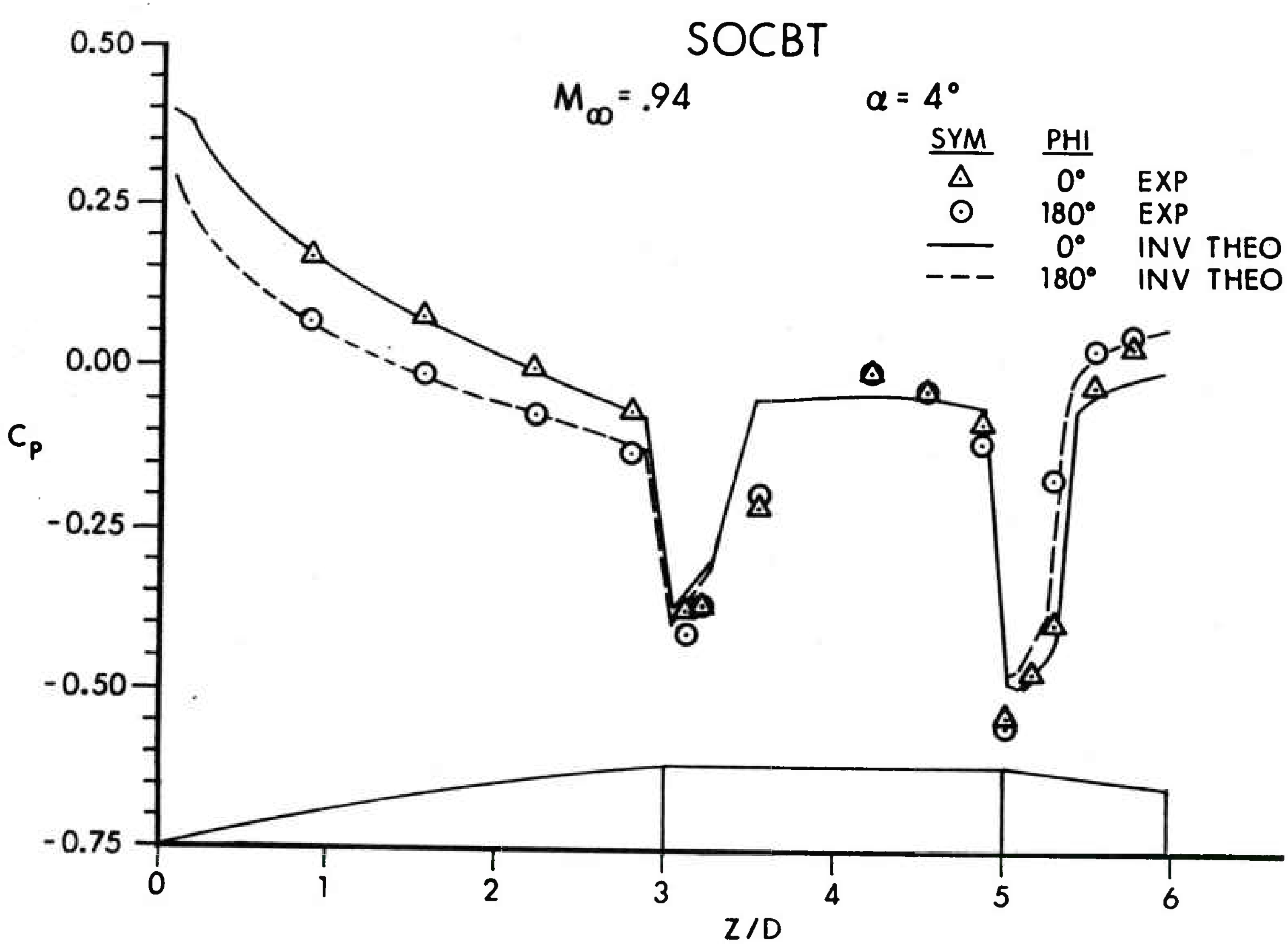


Figure 8b. $M_\infty = 0.94$

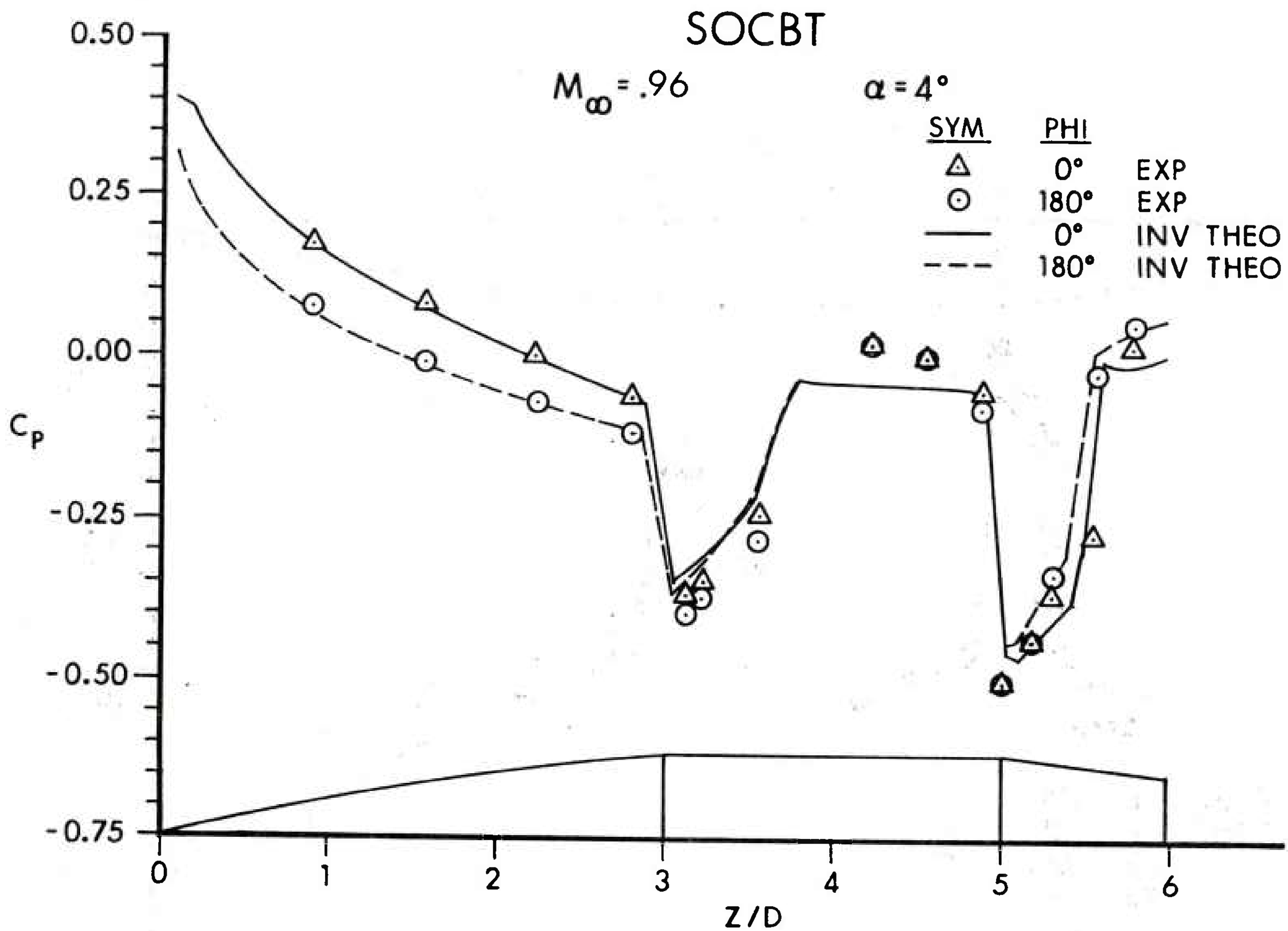


Figure 8c. M_∞ = 0.96

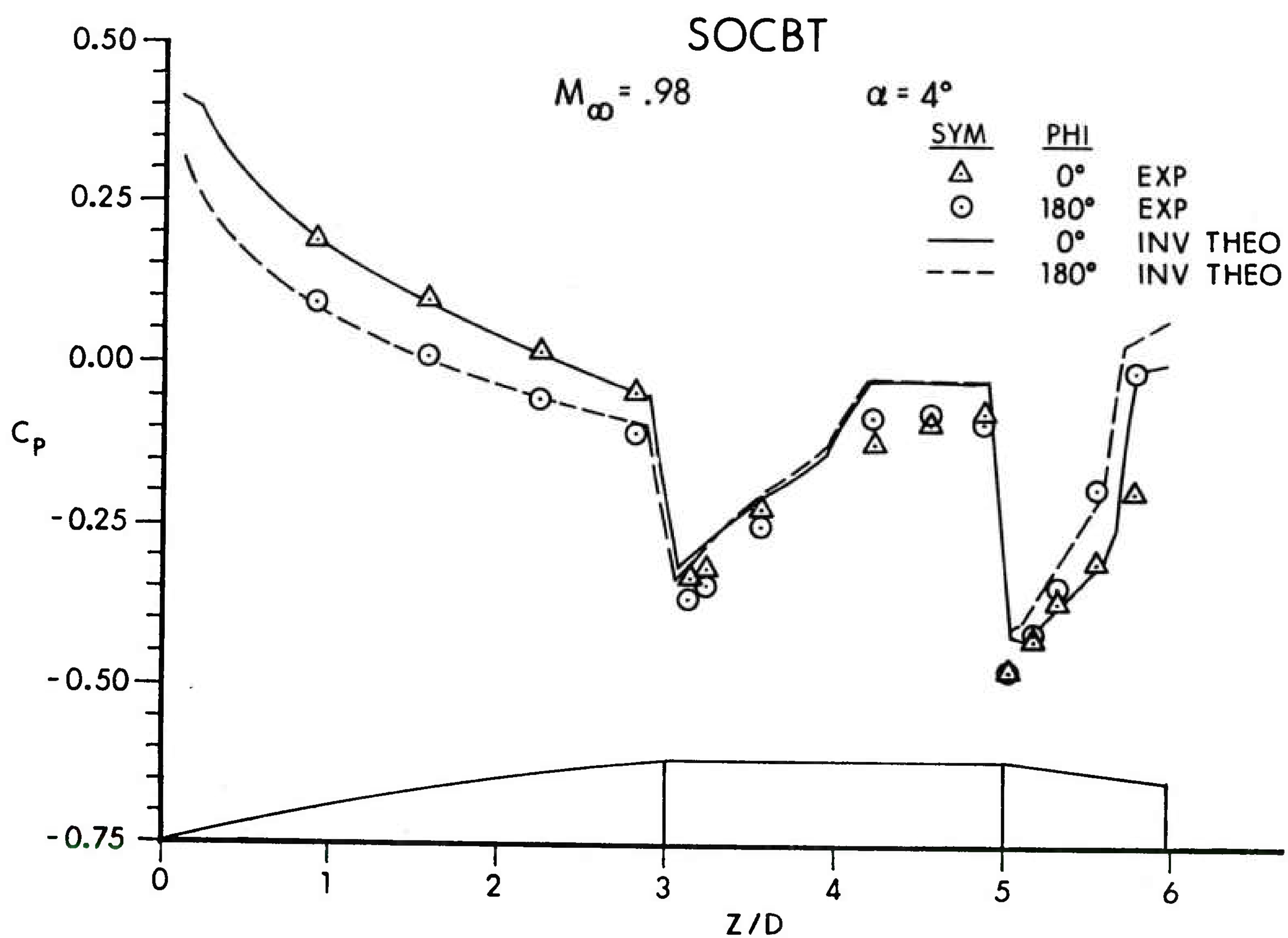


Figure 8d. $M_{\infty} = 0.98$

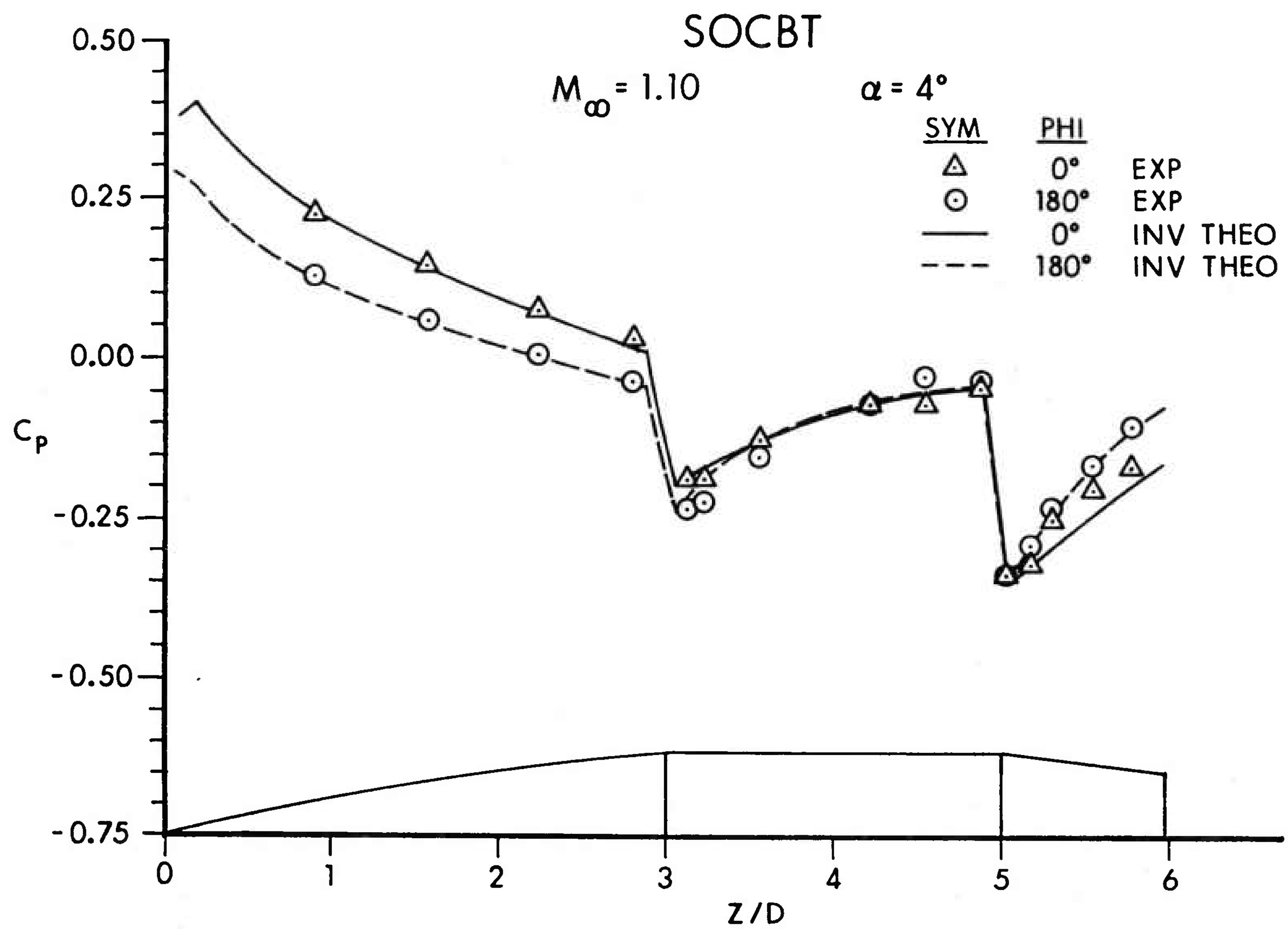


Figure 8e. M_∞ = 1.10

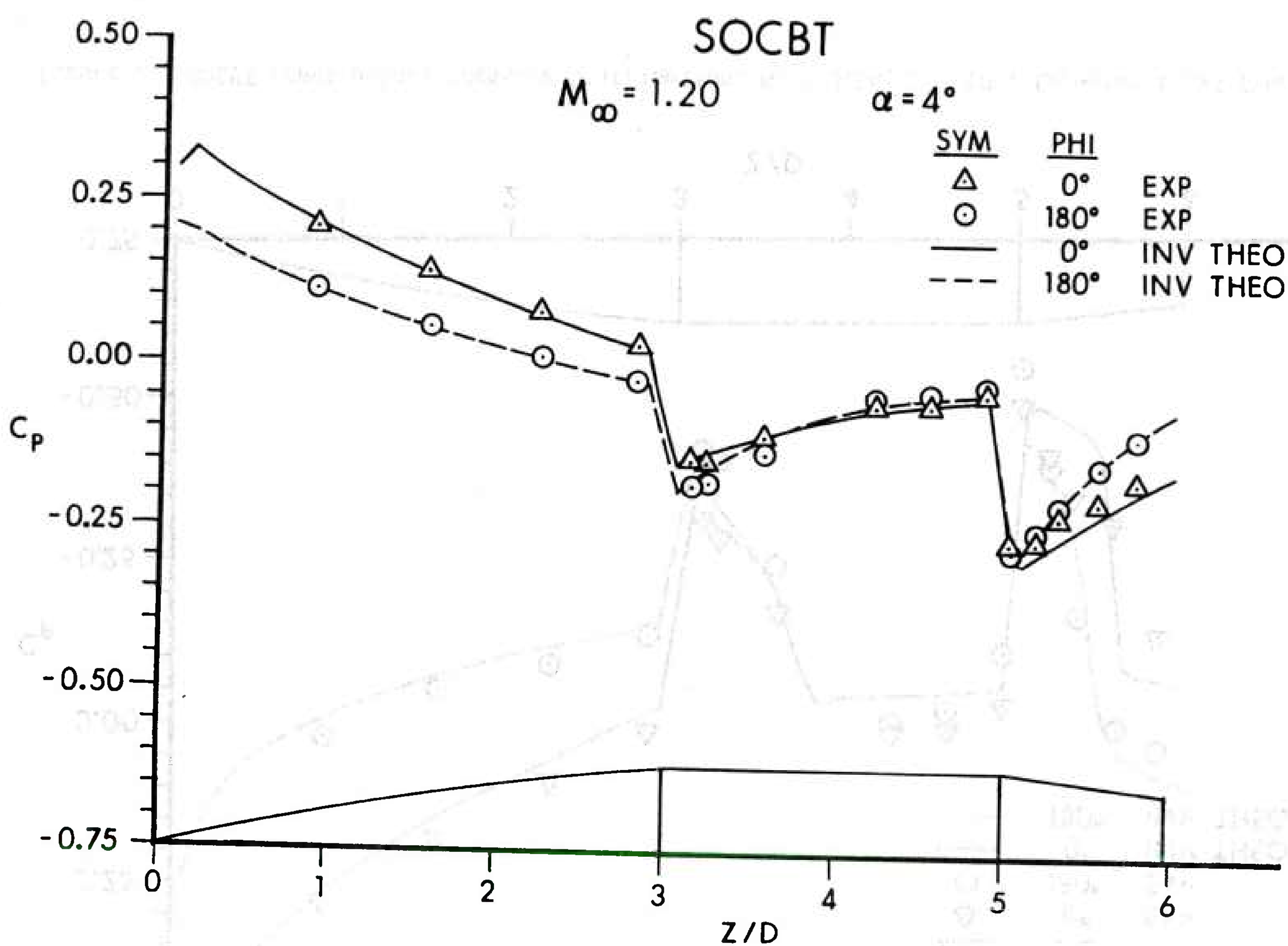


Figure 8f. M_∞ = 1.20

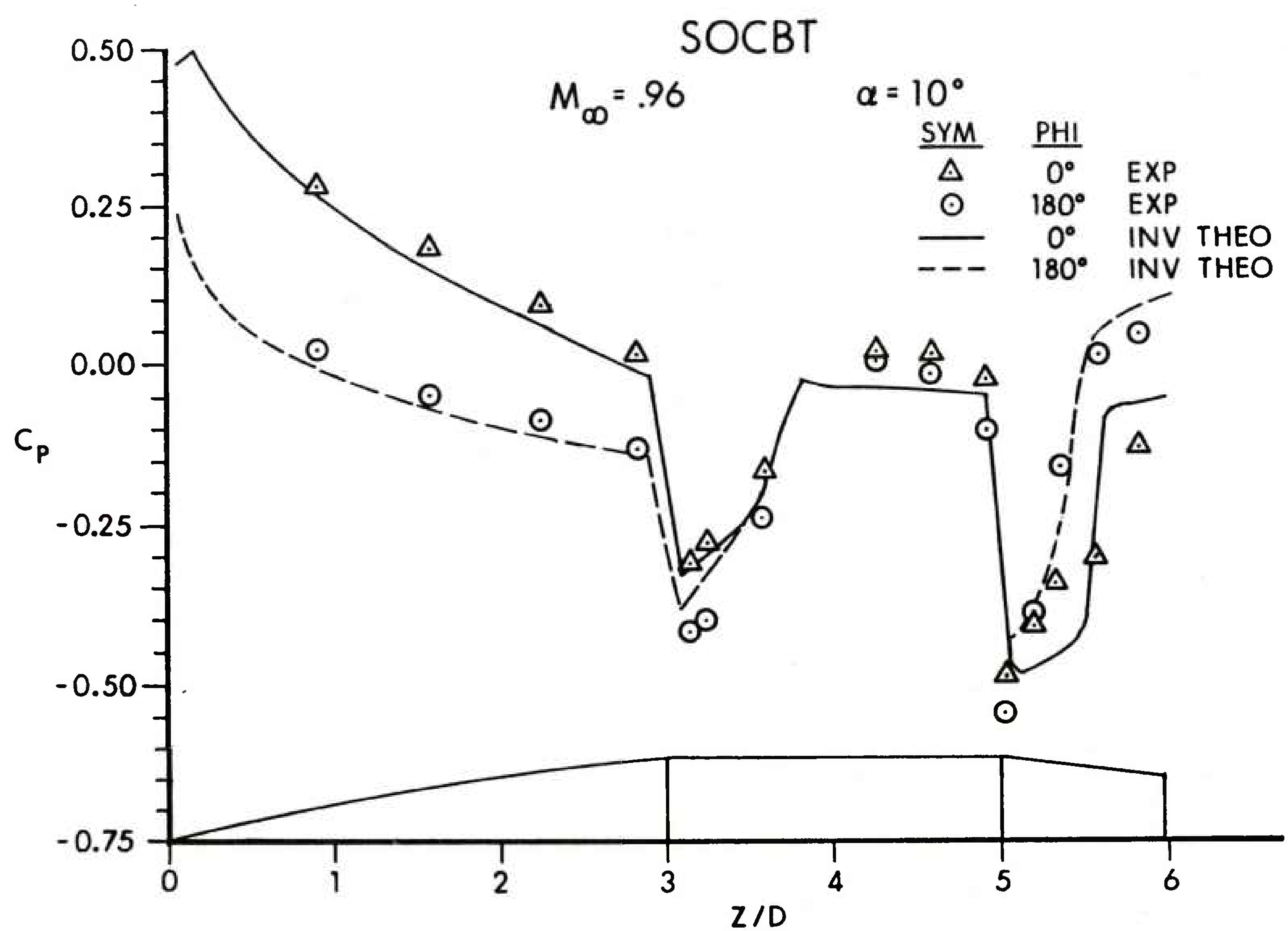


Figure 9. SOCBT Longitudinal Pressure Distribution, M_∞ = 0.96, α = 10°, Experiment and Theory

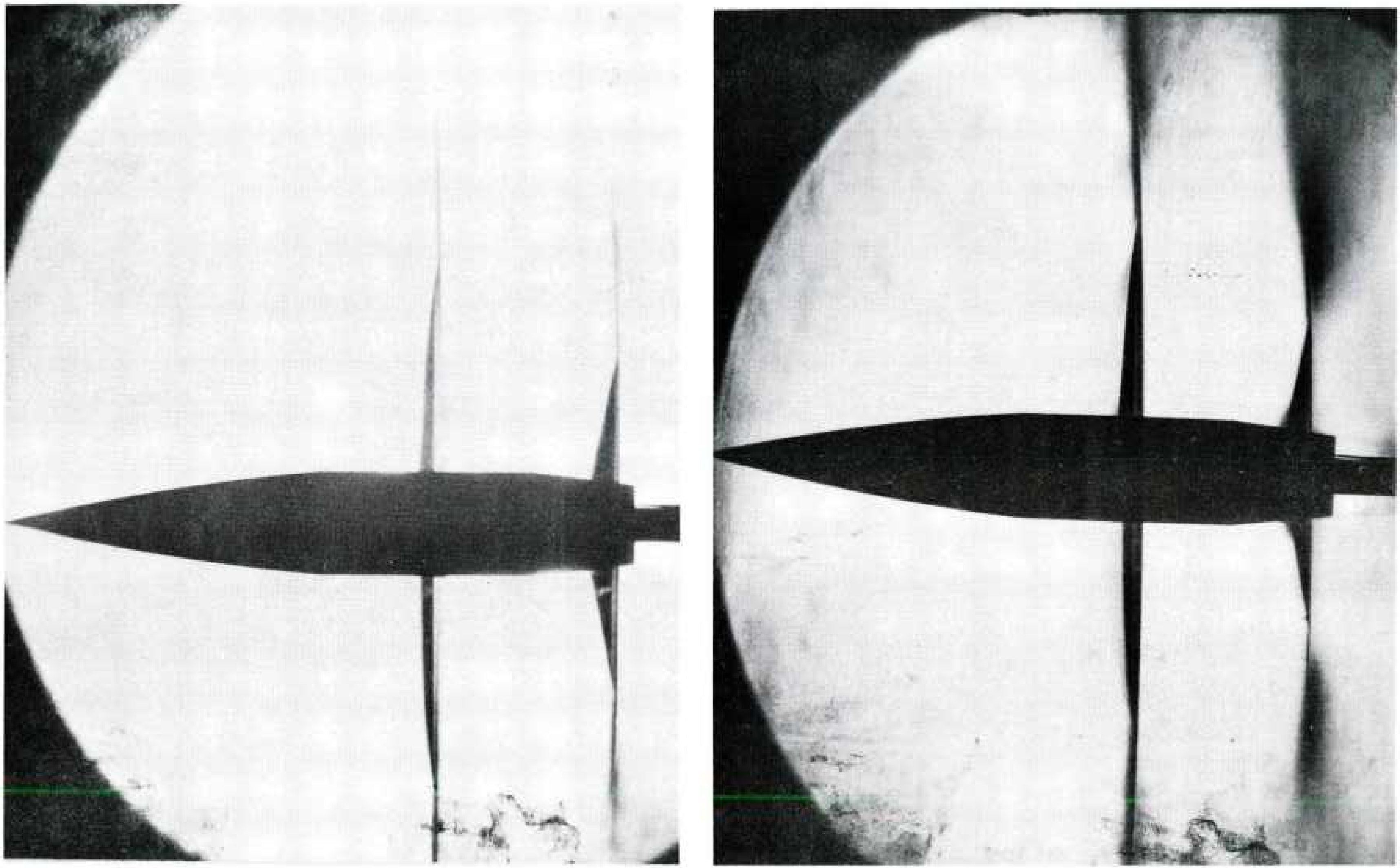


Figure 10. SOCBT Shadowgraphs, $M_\infty = 0.96$

a. $\alpha = 0°, 2°$

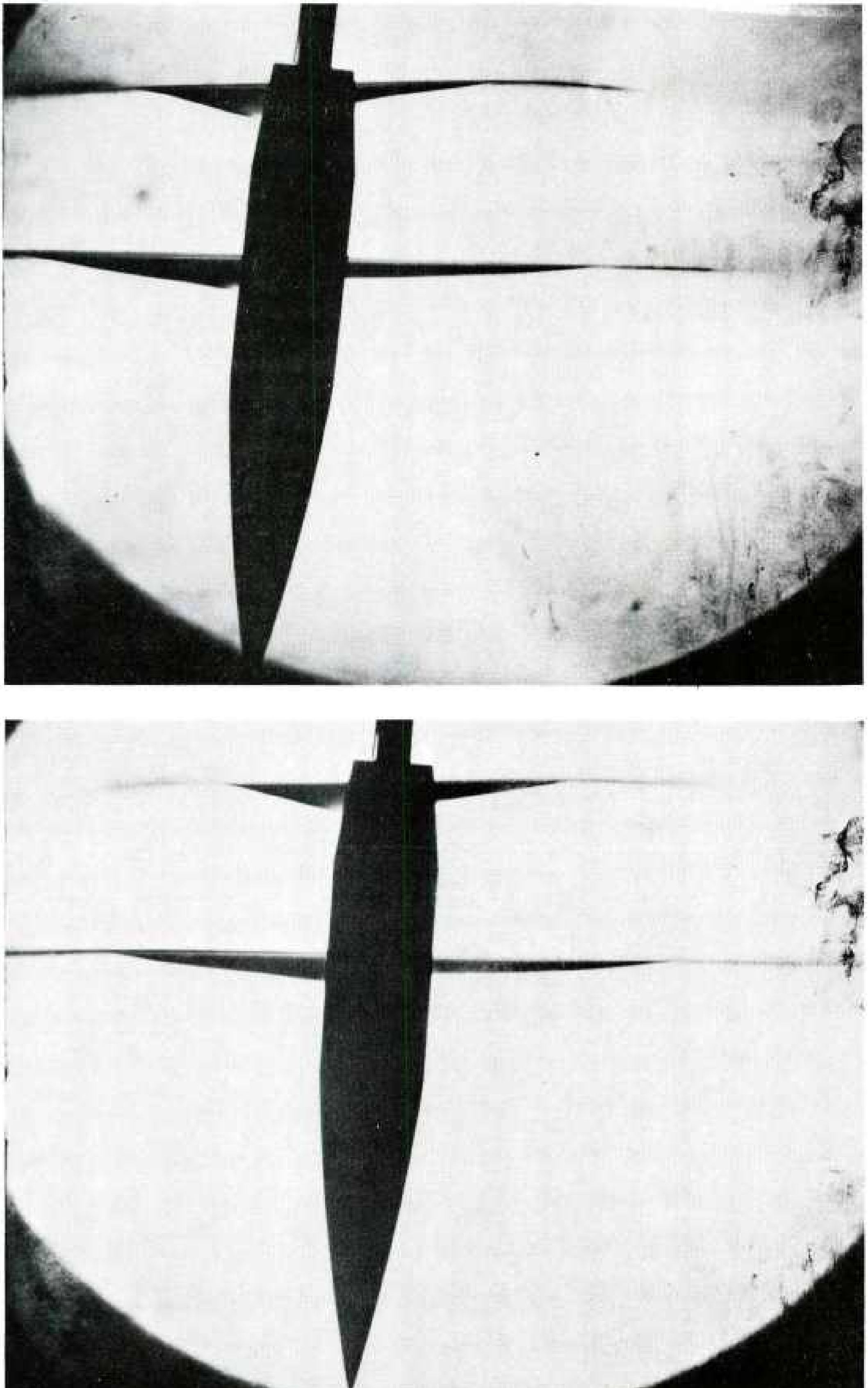


Figure 10b. $\alpha = 4°, 6°$

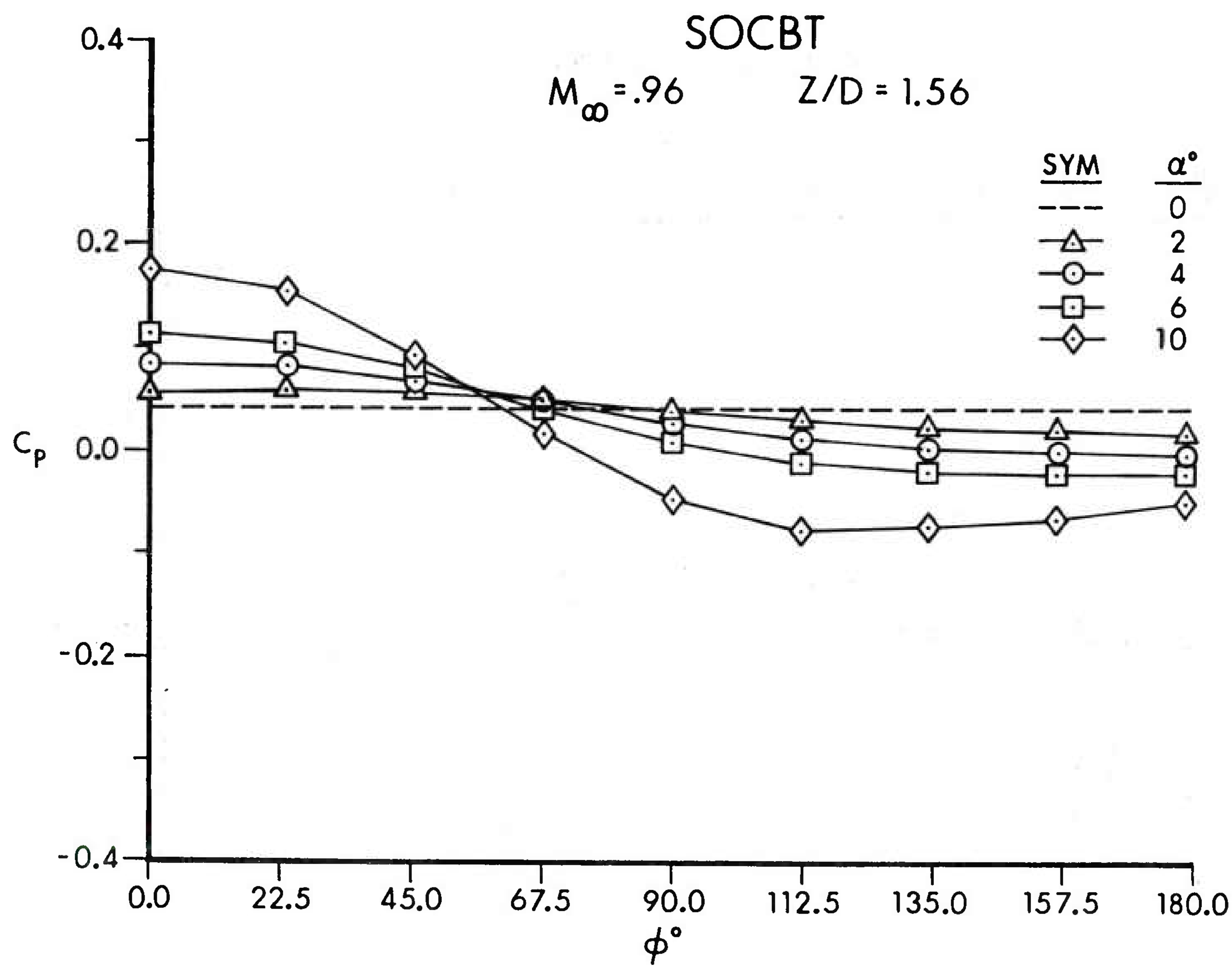


Figure 11. SOCBT Circumferential Pressure Distributions, α = 0, 2, 4, 6, 10 degrees

a. Z/D = 1.56

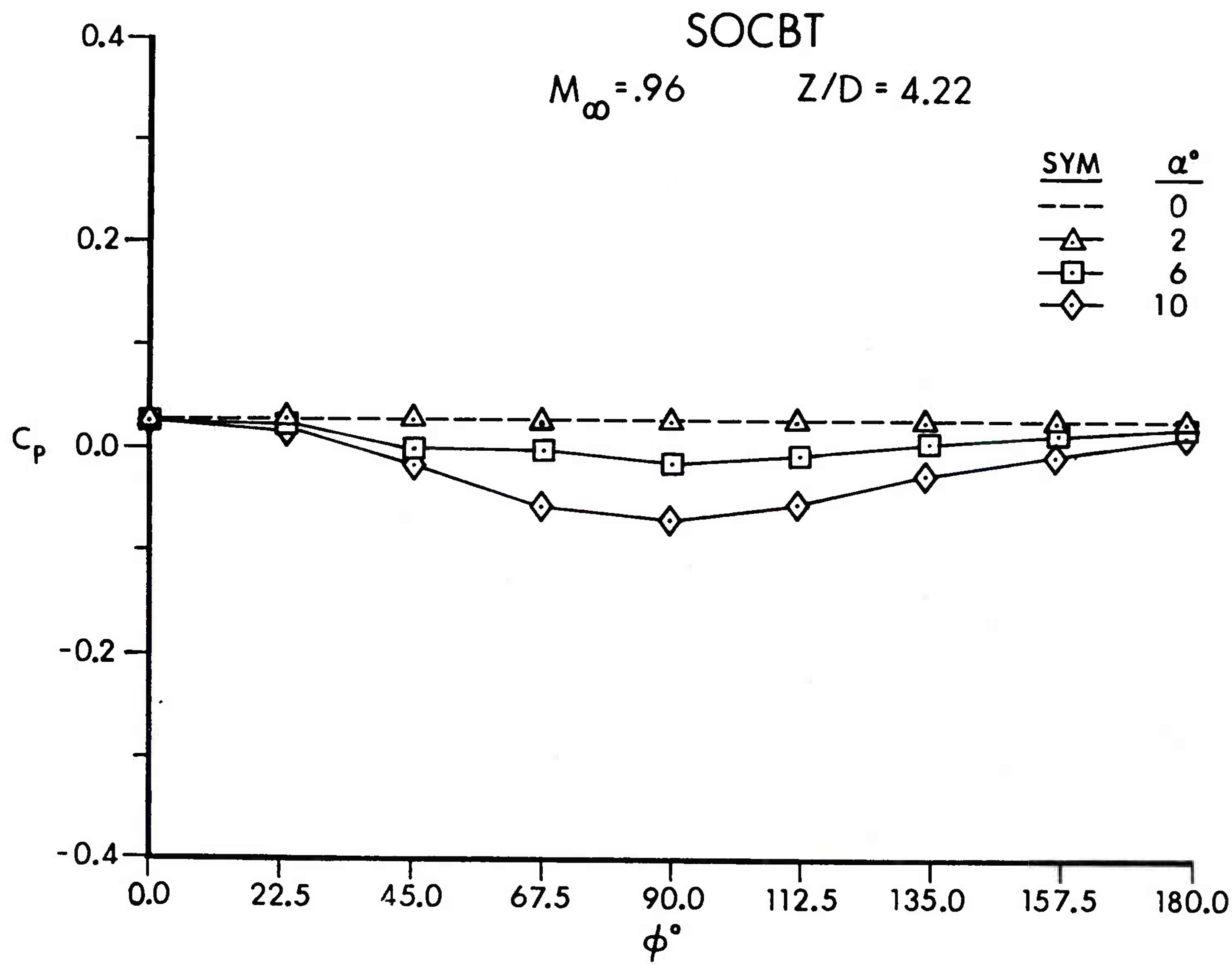


Figure 11b. Z/D = 4.42

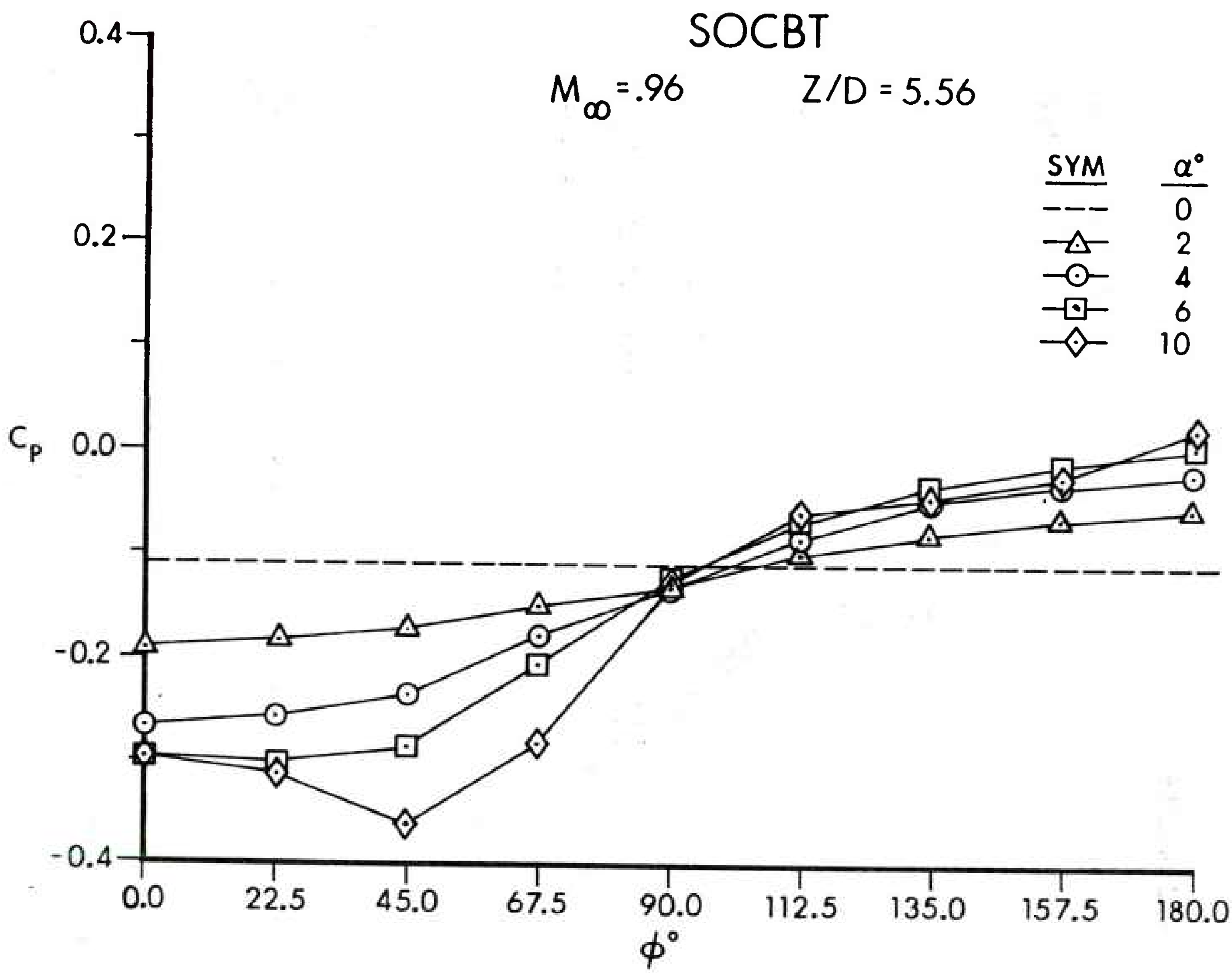


Figure 11c. Z/D = 5.56

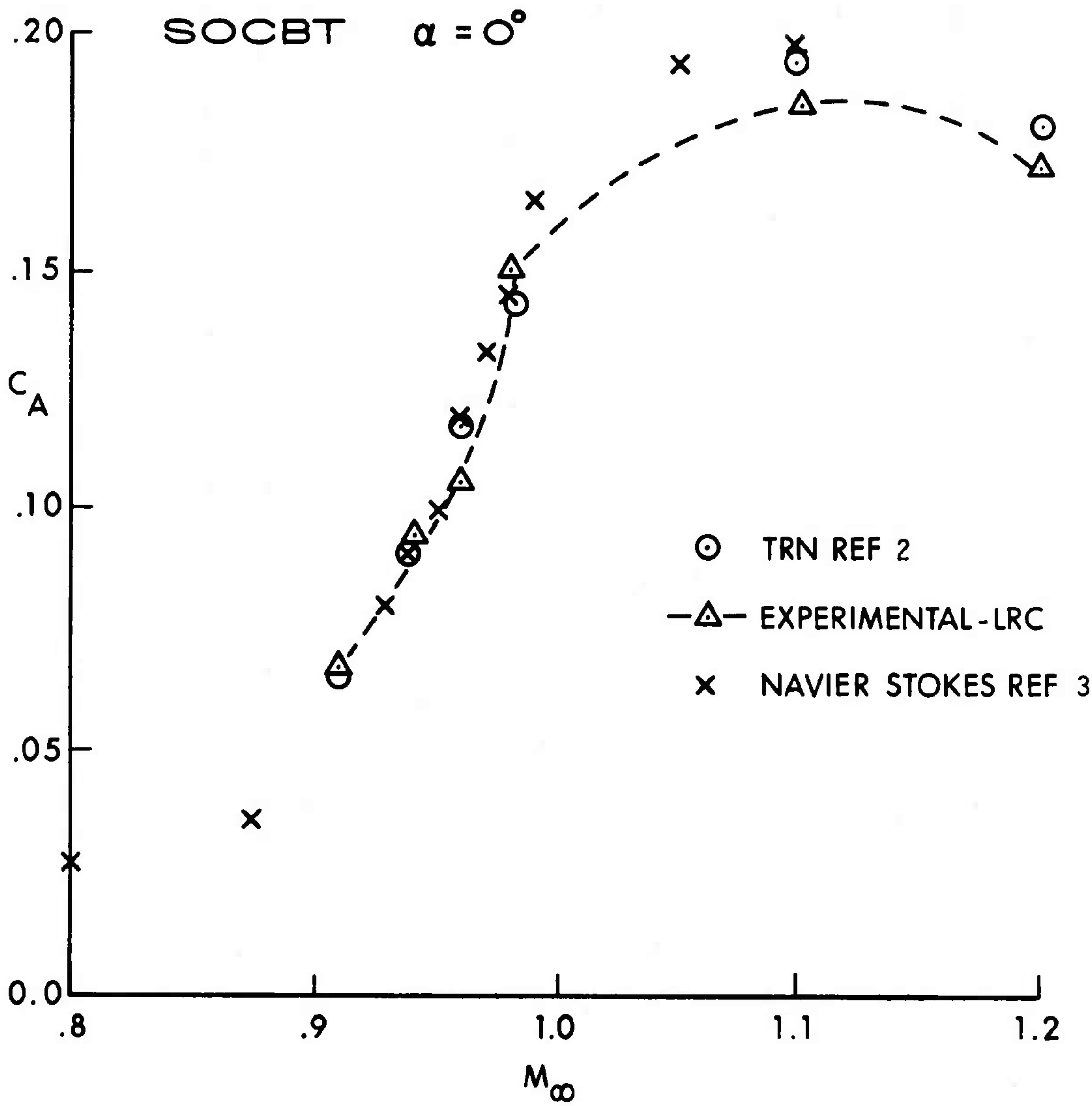


Figure 12. C_A Versus M_∞, SOCBT, Experiment and Theory

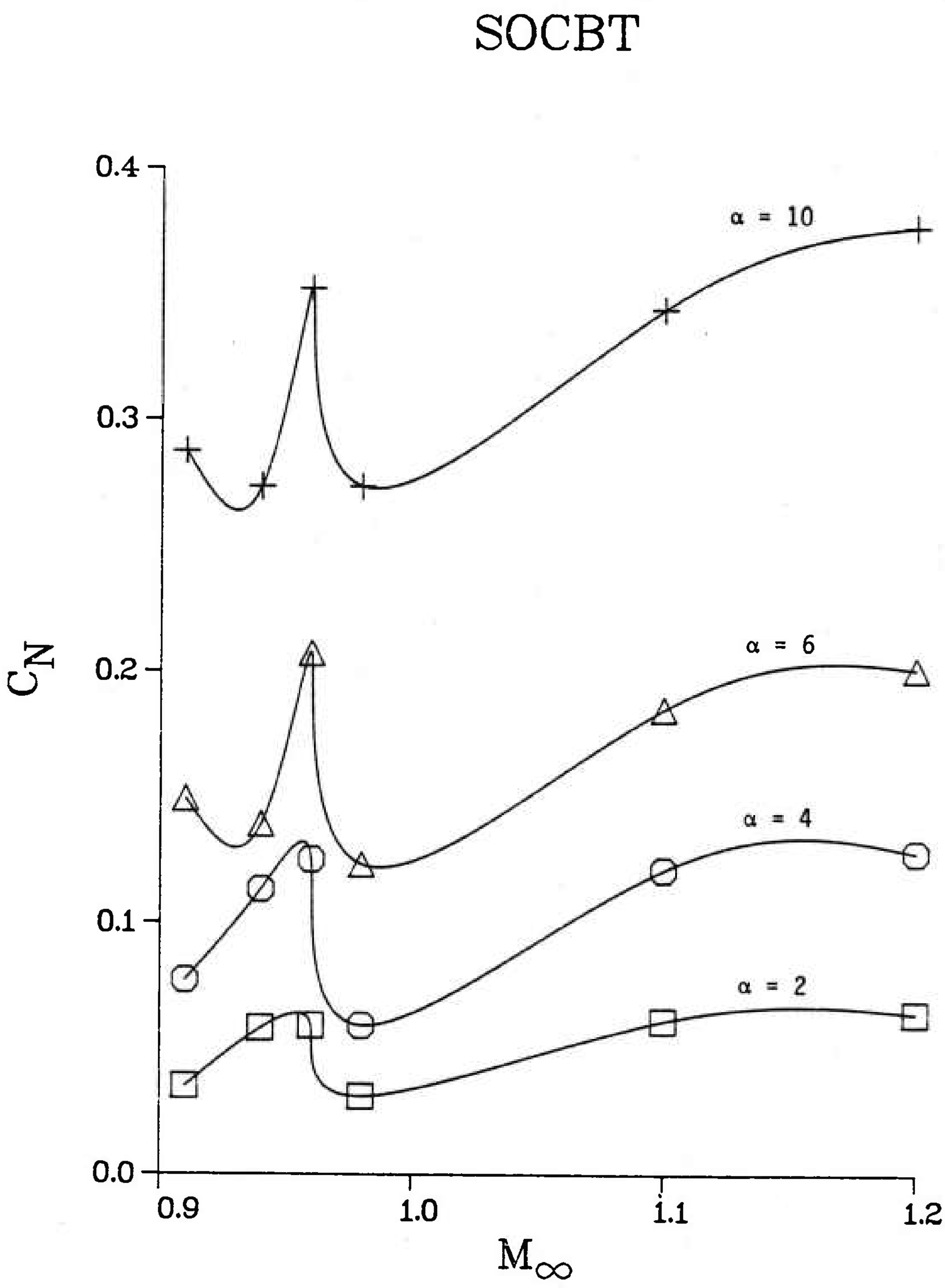


Figure 13. SOCBT Static Stability

a. C_N Versus M_∞

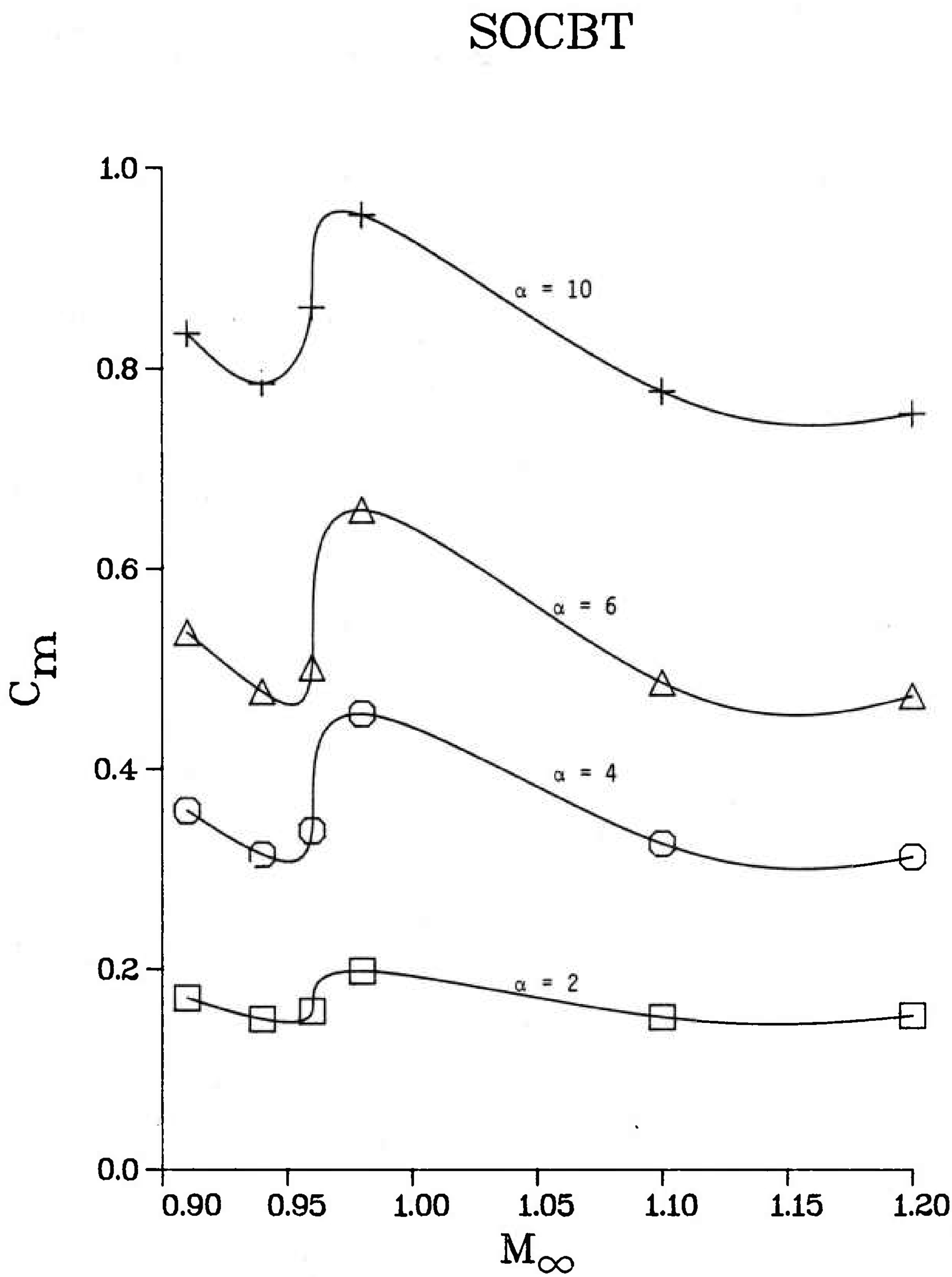


Figure 13b. C_m Versus M_∞

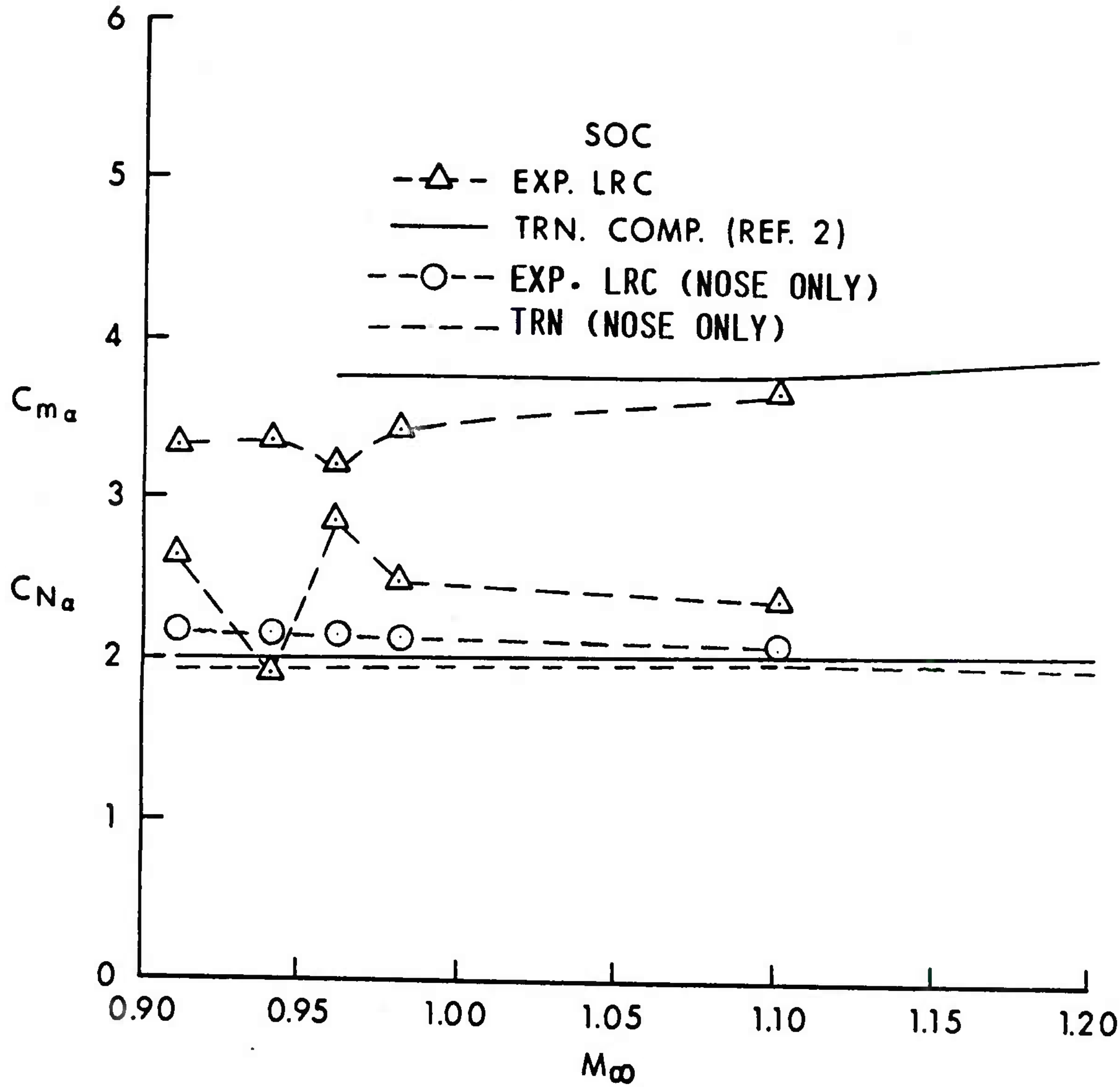


Figure 14. SOC Static Stability, C_{m_α} and C_{N_α} vs M_∞

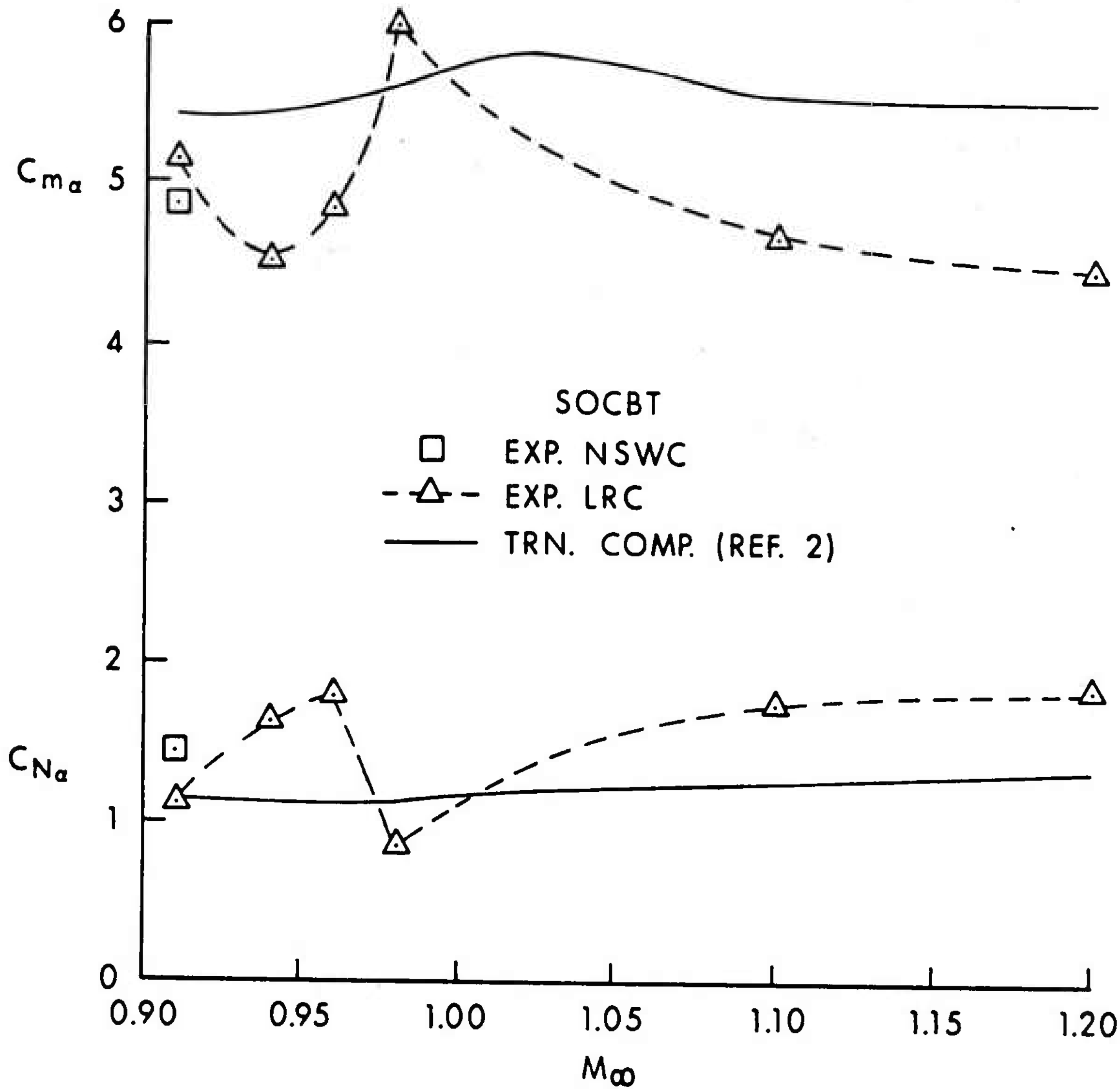


Figure 15. SOCBT Static Stability, C_{m_α} and C_{N_α} vs M_∞

TABLE 1. SUMMARY OF TEST CONDITION

SOCBT, SOC*

M_∞	P_0-atm	P_∞-atm	T_0-^0C	q_∞-atm	$Re_\ell \times 10^{-6}$
.91	1.0	.59	49	.34	4.5
.94	1.0	.57	49	.35	4.6
.96	1.0	.55	49	.36	4.6
.98	1.0	.54	49	.36	4.6
1.10	1.0	.47	49	.40	4.7
1.20	1.03	.40	49	.40	4.6

Angles of Attack (α) - 0, 2, 4, 6, 10 degrees

Angles of Roll (ϕ) - 0 to 180 degrees @ 22.5° increments

* SOC - Data not obtained at; ϕ = 90°, M_∞ = 1.1; ϕ = 67.5°, 112.5°, M_∞ = 1.2.

TABLE 2. SOC PRESSURE COEFFICIENT DATA, α = 0°

SOC

ALPHA=0 PHI=0

MACH	Z/D=.89	1.56	2.22	2.79	3.13	3.22	3.56	4.22	4.55	4.88	5.32	5.61	5.78
.91	.114	.033	-.038	-.114	-.460	-.311	-.043	-.023	-.026	-.026	-.038	-.043	-.055
.94	.125	.040	-.033	-.099	-.422	-.392	-.065	-.008	-.017	-.019	-.033	-.038	-.050
.96	.131	.047	-.026	-.087	-.405	-.366	-.255	.011	.006	-.003	-.022	-.030	-.043
.98	.146	.059	-.014	-.069	-.375	-.336	-.236	-.122	-.098	-.065	-.018	-.016	-.027
1.10	.184	.112	.046	.004	-.236	-.206	-.140	-.073	-.056	-.047	-.021	-.012	-.014
1.20	.162	.107	.050	.007	-.188	-.169	-.119	-.059	-.050	-.039	-.035	-.025	-.019

TABLE 3. SOC PRESSURE COEFFICIENT DATA, α = 2, 4, 6, and 10 DEGREES

a. $M_\infty = 0.91$

SOC MACH= .91 ALPHA= 2.00 REL=4500000.

PHI	Z/D=.89	1.56	2.22	2.79	3.13	3.22	3.56	4.22	4.55	4.88	5.32	5.61	5.78
0.0	.143	.057	-.018	-.097	-.450	-.333	-.044	-.022	-.024	-.025	-.036	-.039	-.048
22.5	.143	.058	-.016	-.096	-.455	-.346	-.042	-.021	-.025	-.024	-.036	-.039	-.049
45.0	.134	.046	-.028	-.101	-.399	-.349	-.004	-.020	-.026	-.026	-.047	-.042	-.053
67.5	.122	.036	-.037	-.110	-.392	-.353	-.003	-.022	-.026	-.029	-.045	-.045	-.057
90.0	.108	.024	-.046	-.116	-.393	-.358	-.001	-.021	-.026	-.026	-.044	-.044	-.057
112.5	.102	.017	-.053	-.123	-.393	-.363	-.001	-.024	-.026	-.029	-.046	-.047	-.059
135.0	.098	.016	-.051	-.123	-.475	-.367	-.037	-.023	-.028	-.026	-.046	-.048	-.063
157.5	.092	.011	-.058	-.130	-.477	-.316	-.044	-.025	-.025	-.027	-.039	-.047	-.062
180.0	.090	.010	-.058	-.131	-.468	-.282	-.044	-.025	-.026	-.028	-.039	-.047	-.063

SOC MACH= .91 ALPHA= 4.00 REL=4500000.

PHI	Z/D=.89	1.56	2.22	2.79	3.13	3.22	3.56	4.22	4.55	4.88	5.32	5.61	5.78
0.0	.173	.086	.007	-.077	-.432	-.319	-.042	-.018	-.020	-.021	-.034	-.036	-.046
22.5	.168	.081	.003	-.081	-.443	-.331	-.043	-.018	-.020	-.021	-.034	-.036	-.047
45.0	.146	.057	-.018	-.094	-.394	-.346	-.012	-.022	-.030	-.026	-.048	-.043	-.055
67.5	.122	.035	-.040	-.115	-.409	-.361	-.022	-.031	-.035	-.038	-.054	-.054	-.067
90.0	.099	.014	-.056	-.125	-.480	-.374	-.041	-.035	-.036	-.039	-.057	-.059	-.071
112.5	.082	-.001	-.069	-.137	-.407	-.387	-.013	-.035	-.037	-.039	-.056	-.058	-.071
135.0	.072	-.007	-.071	-.138	-.459	-.379	-.022	-.026	-.034	-.032	-.052	-.054	-.070
157.5	.069	-.009	-.074	-.145	-.479	-.314	-.045	-.028	-.025	-.030	-.042	-.052	-.069
180.0	.066	-.009	-.073	-.143	-.464	-.258	-.040	-.022	-.027	-.026	-.039	-.051	-.070

TABLE 3a. (CONTINUED)

SOC MACH= .91 ALPHA= 6.00 REL=4500000.

PHI \ Z/D=	.89	1.56	2.22	2.79	3.13	3.22	3.56	4.22	4.55	4.88	5.32	5.61	5.78
0.0	.206	.115	.032	-.056	-.413	-.299	-.040	-.011	-.014	-.014	-.028	-.030	-.041
22.5	.194	.106	.024	-.063	-.427	-.314	-.043	-.016	-.018	-.019	-.032	-.034	-.046
45.0	.159	.068	-.009	-.088	-.402	-.343	-.023	-.029	-.037	-.036	-.058	-.053	-.066
67.5	.117	.029	-.048	-.124	-.442	-.381	-.050	-.049	-.051	-.054	-.070	-.070	-.083
90.0	.079	-.005	-.075	-.139	-.500	-.393	-.066	-.053	-.051	-.058	-.076	-.078	-.090
112.5	.054	-.028	-.094	-.156	-.503	-.405	-.051	-.046	-.052	-.049	-.066	-.069	-.084
135.0	.043	-.036	-.097	-.158	-.508	-.353	-.035	-.033	-.036	-.037	-.057	-.061	-.078
157.5	.044	-.030	-.090	-.158	-.472	-.304	-.043	-.027	-.023	-.030	-.044	-.057	-.078
180.0	.043	-.029	-.088	-.157	-.447	-.222	-.038	-.019	-.023	-.023	-.039	-.052	-.072

SOC MACH= .91 ALPHA=10.00 REL=4500000.

PHI \ Z/D=	.89	1.56	2.22	2.79	3.13	3.22	3.56	4.22	4.55	4.88	5.32	5.61	5.78
0.0	.273	.177	.087	-.009	-.360	-.160	-.030	.009	.009	.008	-.006	-.008	-.022
22.5	.246	.153	.065	-.031	-.383	-.272	-.043	-.005	-.013	-.008	-.022	-.025	-.041
45.0	.177	.082	-.001	-.090	-.409	-.343	-.067	-.053	-.058	-.058	-.081	-.075	-.090
67.5	.089	-.002	-.081	-.162	-.487	-.426	-.117	-.098	-.099	-.103	-.119	-.119	-.134
90.0	.022	-.065	-.123	-.201	-.547	-.412	-.124	-.111	-.095	-.113	-.133	-.135	-.147
112.5	-.012	-.093	-.144	-.214	-.572	-.398	-.103	-.088	-.092	-.087	-.102	-.107	-.123
135.0	-.014	-.088	-.132	-.197	-.546	-.239	-.060	-.048	-.051	-.050	-.069	-.082	-.106
157.5	0.000	-.068	-.121	-.187	-.406	-.207	-.046	-.034	-.032	-.045	-.067	-.085	-.108
180.0	.007	-.059	-.110	-.175	-.417	-.150	-.031	-.012	-.017	-.020	-.041	-.050	-.068

TABLE 3b. $M_\infty = 0.94$

SOC MACH= .94 ALPHA= 2.00 REL=4545000.

PHI \ Z/D=	.89	1.56	2.22	2.79	3.13	3.22	3.56	4.22	4.55	4.88	5.32	5.61	5.78
0.0	.152	.065	-.011	-.081	-.411	-.378	-.071	-.005	-.016	-.017	-.030	-.033	-.043
22.5	.153	.065	-.011	-.081	-.416	-.376	-.080	-.006	-.013	-.019	-.033	-.036	-.046
45.0	.142	.052	-.022	-.087	-.418	-.377	-.195	-.002	-.015	-.018	-.041	-.036	-.048
67.5	.132	.044	-.031	-.095	-.421	-.378	-.259	-.004	-.016	-.022	-.040	-.040	-.053
90.0	.120	.033	-.039	-.101	-.423	-.377	-.256	-.003	-.016	-.020	-.040	-.040	-.053
112.5	.109	.023	-.048	-.109	-.426	-.376	-.184	-.006	-.017	-.021	-.040	-.041	-.054
135.0	.107	.023	-.047	-.111	-.436	-.373	-.064	-.007	-.017	-.021	-.040	-.042	-.057
157.5	.103	.020	-.050	-.113	-.435	-.399	-.062	-.009	-.016	-.021	-.035	-.044	-.059
180.0	.099	.018	-.051	-.113	-.430	-.401	-.063	-.006	-.016	-.019	-.033	-.042	-.059

SOC MACH= .94 ALPHA= 4.00 REL=4545000.

PHI \ Z/D=	.89	1.56	2.22	2.79	3.13	3.22	3.56	4.22	4.55	4.88	5.32	5.61	5.78
0.0	.182	.093	.013	-.061	-.396	-.360	-.097	-.002	-.012	-.014	-.028	-.030	-.040
22.5	.178	.090	.010	-.065	-.405	-.368	-.090	-.004	-.012	-.016	-.030	-.032	-.043
45.0	.156	.065	-.011	-.081	-.414	-.379	-.240	-.007	-.019	-.022	-.045	-.039	-.051
67.5	.131	.041	-.034	-.100	-.429	-.391	-.237	-.015	-.025	-.031	-.048	-.048	-.061
90.0	.108	.020	-.051	-.112	-.447	-.396	-.098	-.018	-.026	-.032	-.051	-.052	-.065
112.5	.091	.006	-.063	-.123	-.438	-.401	-.191	-.014	-.028	-.031	-.050	-.053	-.066
135.0	.081	-.001	-.066	-.124	-.454	-.377	-.050	-.007	-.021	-.023	-.047	-.047	-.064
157.5	.077	-.002	-.067	-.128	-.443	-.409	-.052	-.009	-.014	-.021	-.036	-.047	-.066
180.0	.074	-.004	-.069	-.129	-.437	-.407	-.051	-.006	-.014	-.019	-.033	-.045	-.065

TABLE 3b. (CONTINUED)

SOC MACH= .94 ALPHA= 6.00 REL=4545000.

PHI \ Z/D=	.89	1.56	2.22	2.79	3.13	3.22	3.56	4.22	4.55	4.88	5.32	5.61	5.78
0.0	.214	.121	.038	-.041	-.379	-.337	-.094	.003	-.004	-.007	-.020	-.022	-.033
22.5	.202	.112	.029	-.049	-.393	-.353	-.073	0.000	-.009	-.010	-.024	-.026	-.037
45.0	.169	.076	-.004	-.075	-.410	-.378	-.218	-.014	-.028	-.029	-.052	-.045	-.057
67.5	.126	.036	-.042	-.109	-.436	-.404	-.229	-.033	-.043	-.048	-.066	-.065	-.078
90.0	.089	.002	-.070	-.124	-.459	-.420	-.096	-.035	-.042	-.048	-.068	-.070	-.082
112.5	.065	-.019	-.086	-.139	-.471	-.436	-.066	-.029	-.040	-.045	-.064	-.067	-.081
135.0	.054	-.027	-.090	-.142	-.472	-.425	-.047	-.014	-.028	-.031	-.053	-.057	-.075
157.5	.054	-.021	-.083	-.141	-.447	-.423	-.053	-.007	-.013	-.023	-.039	-.054	-.076
180.0	.054	-.021	-.082	-.139	-.437	-.412	-.051	-.002	-.011	-.017	-.034	-.048	-.069

SOC MACH= .94 ALPHA=10.00 REL=4545000.

PHI \ Z/D=	.89	1.56	2.22	2.79	3.13	3.22	3.56	4.22	4.55	4.88	5.32	5.61	5.78
0.0	.282	.185	.095	.007	-.335	-.279	-.070	.020	.014	.014	0.000	0.000	-.012
22.5	.258	.163	.074	-.014	-.359	-.314	-.106	.004	-.003	-.004	-.019	-.019	-.032
45.0	.186	.090	.004	-.077	-.411	-.371	-.198	-.039	-.050	-.049	-.072	-.064	-.077
67.5	.098	.006	-.075	-.148	-.472	-.437	-.192	-.084	-.094	-.096	-.113	-.112	-.126
90.0	.031	-.058	-.117	-.189	-.513	-.463	-.115	-.094	-.086	-.104	-.125	-.126	-.140
112.5	0.000	-.084	-.136	-.200	-.526	-.489	-.092	-.072	-.079	-.083	-.100	-.106	-.122
135.0	-.004	-.082	-.128	-.186	-.509	-.471	-.058	-.035	-.043	-.046	-.065	-.078	-.102
157.5	.011	-.060	-.114	-.170	-.463	-.446	-.046	-.019	-.025	-.041	-.065	-.085	-.110
180.0	.017	-.051	-.103	-.157	-.449	-.414	-.033	.008	-.007	-.010	-.033	-.044	-.064

TABLE 3c. $M_\infty = 0.96$

SOC MACH= .96 ALPHA= 2.00 REL=4578750.

PHI	Z/D=.89	1.56	2.22	2.79	3.13	3.22	3.56	4.22	4.55	4.88	5.32	5.61	5.78
0.0	.161	.072	-.004	-.069	-.392	-.353	-.247	.013	.007	-.001	-.020	-.026	-.037
22.5	.160	.072	-.005	-.070	-.387	-.358	-.248	.013	.012	-.002	-.021	-.026	-.038
45.0	.151	.060	-.015	-.076	-.388	-.361	-.259	.027	.015	-.002	-.030	-.027	-.038
67.5	.140	.050	-.023	-.084	-.392	-.367	-.261	.039	.013	-.001	-.028	-.029	-.041
90.0	.128	.039	-.033	-.090	-.397	-.369	-.265	.035	.012	-.002	-.029	-.030	-.042
112.5	.119	.032	-.039	-.096	-.399	-.372	-.269	.032	.012	-.002	-.029	-.031	-.044
135.0	.117	.031	-.040	-.098	-.405	-.375	-.258	.012	.011	-.004	-.030	-.034	-.050
157.5	.110	.026	-.044	-.102	-.406	-.373	-.257	.010	.008	-.005	-.024	-.035	-.052
180.0	.109	.026	-.044	-.101	-.407	-.376	-.257	.010	.005	-.003	-.022	-.034	-.052

SOC MACH= .96 ALPHA= 4.00 REL=4578750.

PHI	Z/D=.89	1.56	2.22	2.79	3.13	3.22	3.56	4.22	4.55	4.88	5.32	5.61	5.78
0.0	.192	.101	.020	-.049	-.379	-.336	-.233	.017	.011	.003	-.016	-.020	-.031
22.5	.186	.097	.016	-.053	-.376	-.347	-.237	.016	.015	.001	-.018	-.022	-.033
45.0	.166	.073	-.004	-.069	-.385	-.358	-.257	.031	.010	-.005	-.034	-.029	-.041
67.5	.140	.050	-.026	-.088	-.398	-.372	-.271	.025	.002	-.011	-.037	-.037	-.049
90.0	.117	.028	-.044	-.100	-.415	-.381	-.264	.009	.001	-.013	-.038	-.042	-.055
112.5	.099	.013	-.057	-.112	-.413	-.391	-.288	.020	0.000	-.013	-.038	-.042	-.056
135.0	.091	.008	-.058	-.111	-.422	-.380	-.271	.018	.005	-.007	-.037	-.039	-.056
157.5	.086	.005	-.061	-.115	-.412	-.382	-.256	.010	.011	-.005	-.025	-.039	-.059
180.0	.084	.005	-.061	-.114	-.411	-.379	-.254	.012	.008	-.002	-.021	-.036	-.057

TABLE 3c. (CONTINUED)

SOC MACH= .96 ALPHA= 6.00 REL=4578750.

PHI \ Z/D=	.89	1.56	2.22	2.79	3.13	3.22	3.56	4.22	4.55	4.88	5.32	5.61	5.78
0.0	.223	.130	.045	-.028	-.364	-.316	-.215	.022	.017	.010	-.009	-.012	-.022
22.5	.211	.120	.036	-.037	-.365	-.333	-.223	.018	.015	.004	-.015	-.018	-.029
45.0	.176	.082	.002	-.065	-.383	-.355	-.255	.020	0.000	-.012	-.041	-.036	-.046
67.5	.134	.043	-.034	-.097	-.407	-.381	-.287	.002	-.017	-.029	-.052	-.052	-.064
90.0	.099	.010	-.062	-.113	-.426	-.396	-.287	-.011	-.016	-.032	-.058	-.060	-.073
112.5	.075	-.011	-.080	-.126	-.439	-.410	-.290	-.002	-.015	-.028	-.052	-.057	-.071
135.0	.063	-.020	-.084	-.128	-.441	-.403	-.277	.009	-.003	-.014	-.041	-.047	-.066
157.5	.062	-.016	-.078	-.128	-.418	-.395	-.249	.009	.011	-.007	-.029	-.045	-.068
180.0	.063	-.014	-.075	-.124	-.413	-.387	-.243	.015	.010	0.000	-.021	-.038	-.061

SOC MACH= .96 ALPHA=10.00 REL=4578750.

PHI \ Z/D=	.89	1.56	2.22	2.79	3.13	3.22	3.56	4.22	4.55	4.88	5.32	5.61	5.78
0.0	.294	.196	.104	.021	-.325	-.265	-.167	.035	.034	.031	.012	.011	.002
22.5	.265	.170	.080	-.002	-.335	-.298	-.188	.021	.020	.011	-.006	-.008	-.018
45.0	.196	.098	.012	-.065	-.384	-.352	-.252	-.004	-.025	-.034	-.062	-.041	-.065
67.5	.109	.016	-.066	-.135	-.443	-.415	-.320	-.051	-.069	-.079	-.101	-.101	-.113
90.0	.042	-.048	-.109	-.179	-.481	-.438	-.341	-.063	-.078	-.085	-.112	-.114	-.126
112.5	.008	-.077	-.128	-.191	-.495	-.460	-.337	-.045	-.052	-.065	-.087	-.095	-.112
135.0	.005	-.074	-.120	-.173	-.473	-.442	-.282	-.011	-.020	-.031	-.054	-.069	-.094
157.5	.020	-.053	-.108	-.156	-.430	-.418	-.205	-.001	-.001	-.027	-.057	-.079	-.106
180.0	.025	-.044	-.097	-.144	-.423	-.394	-.205	.024	.016	.008	-.020	-.032	-.054

TABLE 3d. $M_\infty = 0.98$

SOC MACH= .98 ALPHA= 2.00 REL=4612500.

PHI	Z/D=.89	1.56	2.22	2.79	3.13	3.22	3.56	4.22	4.55	4.88	5.32	5.61	5.78
0.0	.172	.084	.006	-.055	-.362	-.324	-.228	-.125	-.101	-.058	-.012	-.009	-.018
22.5	.172	.084	.007	-.056	-.356	-.329	-.229	-.125	-.090	-.055	-.011	-.009	-.018
45.0	.163	.071	-.004	-.062	-.356	-.333	-.240	-.115	-.093	-.067	-.024	-.011	-.019
67.5	.152	.061	-.012	-.070	-.362	-.338	-.243	-.124	-.092	-.048	-.017	-.010	-.019
90.0	.140	.051	-.021	-.076	-.366	-.341	-.246	-.120	-.090	-.066	-.021	-.014	-.023
112.5	.131	.042	-.029	-.083	-.368	-.344	-.250	-.109	-.089	-.058	-.021	-.014	-.023
135.0	.128	.042	-.028	-.083	-.371	-.347	-.240	-.124	-.091	-.050	-.020	-.017	-.032
157.5	.122	.038	-.033	-.086	-.373	-.343	-.242	-.119	-.094	-.049	-.016	-.018	-.034
180.0	.120	.037	-.033	-.086	-.383	-.346	-.240	-.117	-.091	-.061	-.020	-.020	-.036

SOC MACH= .98 ALPHA= 4.00 REL=4612500.

PHI	Z/D=.89	1.56	2.22	2.79	3.13	3.22	3.56	4.22	4.55	4.88	5.32	5.61	5.78
0.0	.203	.111	.030	-.036	-.338	-.309	-.217	-.124	-.102	-.065	-.009	-.003	-.011
22.5	.199	.108	.027	-.039	-.345	-.319	-.220	-.127	-.090	-.057	-.008	-.004	-.013
45.0	.177	.084	.006	-.056	-.354	-.329	-.239	-.130	-.103	-.047	-.022	-.009	-.017
67.5	.152	.061	-.014	-.074	-.366	-.345	-.252	-.130	-.106	-.074	-.029	-.020	-.027
90.0	.129	.039	-.033	-.088	-.385	-.354	-.246	-.136	-.105	-.059	-.027	-.024	-.036
112.5	.112	.024	-.046	-.100	-.382	-.363	-.265	-.123	-.104	-.056	-.026	-.021	-.034
135.0	.103	.019	-.048	-.099	-.388	-.353	-.251	-.115	-.090	-.056	-.027	-.022	-.037
157.5	.099	.017	-.050	-.100	-.380	-.352	-.246	-.116	-.087	-.036	-.015	-.022	-.042
180.0	.096	.016	-.050	-.100	-.387	-.349	-.243	-.111	-.083	-.035	-.013	-.021	-.041

TABLE 3d. (CONTINUED)

SOC MACH= .98 ALPHA= 6.00 REL=4612500.

PHI \ Z/D=	.89	1.56	2.22	2.79	3.13	3.22	3.56	4.22	4.55	4.88	5.32	5.61	5.78
0.0	.233	.139	.055	-.015	-.341	-.290	-.203	-.123	-.101	-.028	.005	.008	0.000
22.5	.225	.133	.048	-.021	-.333	-.305	-.209	-.127	-.095	-.063	-.004	.001	-.007
45.0	.190	.095	.014	-.049	-.351	-.326	-.237	-.149	-.114	-.081	-.030	-.015	-.022
67.5	.147	.055	-.023	-.083	-.375	-.354	-.267	-.152	-.130	-.097	-.045	-.035	-.043
90.0	.111	.021	-.052	-.101	-.395	-.367	-.270	-.156	-.123	-.073	-.045	-.041	-.051
112.5	.087	0.000	-.069	-.114	-.407	-.380	-.270	-.140	-.116	-.077	-.041	-.037	-.050
135.0	.075	-.009	-.073	-.119	-.406	-.372	-.258	-.123	-.098	-.057	-.030	-.030	-.047
157.5	.075	-.003	-.066	-.115	-.386	-.364	-.246	-.112	-.083	-.046	-.021	-.030	-.052
180.0	.074	-.003	-.065	-.113	-.388	-.356	-.242	-.104	-.079	-.032	-.013	-.021	-.043

SOC MACH= .98 ALPHA=10.00 REL=4612500.

PHI \ Z/D=	.89	1.56	2.22	2.79	3.13	3.22	3.56	4.22	4.55	4.88	5.32	5.61	5.78
0.0	.305	.207	.116	.037	-.299	-.243	-.155	-.106	-.093	-.058	0.000	.026	.022
22.5	.278	.182	.092	.013	-.308	-.298	-.178	-.127	.020	-.070	.005	.014	.006
45.0	.196	.098	.012	-.065	-.384	-.326	-.252	-.004	-.152	-.034	-.062	-.041	-.065
67.5	.123	.029	-.052	-.117	-.413	-.391	-.305	-.220	-.190	-.156	-.089	-.080	-.088
90.0	.054	-.037	-.099	-.165	-.453	-.413	-.331	-.220	-.170	-.142	-.099	-.095	-.104
112.5	.022	-.065	-.115	-.177	-.463	-.435	-.324	-.185	-.150	-.113	-.073	-.074	-.090
135.0	.018	-.062	-.110	-.161	-.441	-.411	-.284	-.136	-.108	-.059	-.043	-.053	-.078
157.5	.033	-.040	-.097	-.142	-.400	-.387	-.245	-.111	-.084	-.054	-.048	-.062	-.087
180.0	.037	-.143	-.088	-.129	-.400	-.364	-.236	-.088	-.065	-.033	-.013	-.014	-.032

TABLE 3e. $M_\infty = 1.10$

SOC MACH=1.10 ALPHA= 2.00 REL=4725000.

PHI \ Z/D=	.89	1.56	2.22	2.79	3.13	3.22	3.56	4.22	4.55	4.88	5.32	5.61	5.78
0.0	.212	.138	.069	.020	-.222	-.191	-.128	-.072	-.063	-.048	-.035	-.005	-.006
22.5	.211	.137	.070	.024	-.212	-.198	-.130	-.074	-.071	-.048	-.019	-.003	-.005
45.0	.201	.125	.058	.014	-.215	-.202	-.144	-.084	-.077	-.040	-.025	-.002	-.004
67.5	.189	.114	.050	.007	-.222	0.000	-.149	-.091	0.000	-.044	-.020	-.001	-.003
90.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
112.5	.169	.096	.035	-.006	-.228	0.000	-.154	-.092	0.000	-.042	-.018	-.009	-.010
135.0	.167	.096	.036	-.007	-.232	-.217	-.145	-.076	-.055	-.039	-.023	-.011	-.015
157.5	.160	.092	.032	-.009	-.234	-.214	-.145	-.072	-.062	-.037	-.020	-.014	-.017
180.0	.158	.090	.028	-.012	-.245	-.216	-.145	-.069	-.057	-.036	-.024	-.016	-.019

SOC MACH=1.10 ALPHA= 4.00 REL=4725000.

PHI \ Z/D=	.89	1.56	2.22	2.79	3.13	3.22	3.56	4.22	4.55	4.88	5.32	5.61	5.78
0.0	.242	.167	.095	.041	-.210	-.177	-.115	-.067	-.063	-.045	-.032	-.012	-.007
22.5	.237	.162	.091	.037	-.202	-.187	-.121	-.076	-.071	-.044	-.017	-.010	-.003
45.0	.217	.138	.071	.020	-.212	-.197	-.140	-.090	-.077	-.044	-.030	-.014	-.006
67.5	.191	.115	.051	.001	-.226	0.000	-.155	-.094	0.000	-.052	-.031	-.022	-.015
90.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
112.5	.150	.077	.022	-.024	-.244	0.000	-.165	-.085	0.000	-.039	-.034	-.017	-.018
135.0	.141	.073	.021	-.027	-.249	-.229	-.155	-.075	-.049	-.036	-.032	-.015	-.015
157.5	.135	.070	.018	-.027	-.243	-.226	-.149	-.070	-.047	-.036	-.022	-.018	-.025
180.0	.134	.069	.015	-.029	-.252	-.221	-.147	-.065	-.043	-.034	-.021	-.017	-.024

TABLE 3e. (CONTINUED)

SOC MACH=1.10 ALPHA= 6.00 REL=4725000.

PHI	Z/D=.89	1.56	2.22	2.79	3.13	3.22	3.56	4.22	4.55	4.88	5.32	5.61	5.78
0.0	.275	.197	.121	.063	-.197	-.162	-.103	-.062	-.059	-.035	-.024	-.005	-.005
22.5	.263	.187	.113	.053	-.192	-.175	-.108	-.072	-.067	-.042	-.017	-.008	-.009
45.0	.228	.151	.080	.026	-.209	-.195	-.140	-.096	-.076	-.050	-.039	-.022	-.021
67.5	.187	.114	.045	-.006	-.234	0.000	-.168	-.094	0.000	-.065	-.048	-.038	-.036
90.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
112.5	.128	.055	.010	-.043	-.265	0.000	-.174	-.096	0.000	-.060	-.047	-.038	-.036
135.0	.115	.047	-.001	-.045	-.264	-.243	-.166	-.074	-.062	-.039	-.034	-.027	-.029
157.5	.114	.052	.002	-.043	-.251	-.234	-.154	-.060	-.048	-.032	-.021	-.022	-.033
180.0	.113	.053	.003	-.042	-.256	-.227	-.148	-.051	-.041	-.031	-.019	-.017	-.027

SOC MACH=1.10 ALPHA=10.00 REL=4725000.

PHI	Z/D=.89	1.56	2.22	2.79	3.13	3.22	3.56	4.22	4.55	4.88	5.32	5.61	5.78
0.0	.344	.265	.181	.113	-.160	-.121	-.064	-.032	-.034	-.025	-.008	.009	.014
22.5	.318	.240	.159	.090	-.167	-.148	-.081	-.058	-.057	-.044	-.019	-.004	.002
45.0	.250	.171	.092	.030	-.210	-.195	-.140	-.114	-.102	-.072	-.067	-.040	-.037
67.5	.166	.090	.018	-.042	-.263	0.000	-.205	-.162	0.000	-.105	-.099	-.082	-.080
90.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
112.5	.063	-.003	-.054	-.101	-.319	0.000	-.222	-.139	0.000	-.076	-.077	-.070	-.074
135.0	.061	.009	-.044	-.087	-.290	-.270	-.187	-.090	-.069	-.043	-.047	-.048	-.060
157.5	.073	.022	-.029	-.067	-.254	-.245	-.153	-.067	-.047	-.038	-.048	-.053	-.067
180.0	.077	.041	-.019	-.059	-.257	-.225	-.141	-.043	-.031	-.015	-.019	-.010	-.014

TABLE 3f. $M_\infty = 1.20$

SOC MACH=1.20 ALPHA= 2.00 REL=4601250.

PHI \ Z/D=	.89	1.56	2.22	2.79	3.13	3.22	3.56	4.22	4.55	4.88	5.32	5.61	5.78
0.0	.190	.130	.072	.023	-.177	-.155	-.110	-.058	-.051	-.040	-.036	-.024	-.017
22.5	.191	.131	.073	.023	-.167	-.159	-.109	-.059	-.052	-.040	-.036	-.024	-.019
45.0	.182	.118	.062	.016	-.170	0.000	-.117	-.063	0.000	-.039	-.046	-.022	-.015
67.5	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
90.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
112.5	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
135.0	.147	.089	.038	-.004	-.188	0.000	-.120	-.061	0.000	-.040	-.041	-.026	-.021
157.5	.140	.087	.036	-.007	-.189	-.176	-.121	-.058	-.051	-.037	-.034	-.025	-.022
180.0	.139	.084	.034	-.008	-.195	-.176	-.122	-.058	-.047	-.037	-.034	-.024	-.018

SOC MACH=1.20 ALPHA= 4.00 REL=4601250.

PHI \ Z/D=	.89	1.56	2.22	2.79	3.13	3.22	3.56	4.22	4.55	4.88	5.32	5.61	5.78
0.0	.221	.159	.097	.043	-.164	-.141	-.097	-.054	-.049	-.039	-.037	-.022	-.015
22.5	.218	.158	.096	.041	-.156	-.149	-.099	-.055	-.054	-.041	-.038	-.023	-.018
45.0	.197	.133	.073	.023	-.167	0.000	-.115	-.069	0.000	-.047	-.052	-.026	-.019
67.5	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
90.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
112.5	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
135.0	.141	.070	.021	-.019	-.202	0.000	-.128	-.064	0.000	-.042	-.042	-.029	-.024
157.5	.119	.066	.019	-.020	-.196	-.184	-.126	-.056	-.047	-.036	-.033	-.025	-.024
180.0	.117	.065	.018	-.021	-.200	-.182	-.123	-.053	-.043	-.034	-.030	-.022	-.022

TABLE 3f. (CONTINUED)

SOC MACH=1.20 ALPHA= 6.00 REL=4601250.

PHI \ Z/D=	.89	1.56	2.22	2.79	3.13	3.22	3.56	4.22	4.55	4.88	5.32	5.61	5.78
0.0	.252	.189	.121	.067	-.148	-.123	-.083	-.046	-.045	-.037	-.033	-.019	-.010
22.5	.244	.183	.115	.060	-.142	-.136	-.089	-.052	-.053	-.043	-.039	-.023	-.017
45.0	.211	.146	.081	.033	-.163	0.000	-.113	-.075	0.000	-.055	-.063	-.037	-.028
67.5	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
90.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
112.5	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
135.0	.098	.046	.004	-.034	-.212	0.000	-.138	-.070	0.000	-.048	-.048	-.034	-.032
157.5	.097	.049	.002	-.031	-.204	-.190	-.127	-.056	-.045	-.036	-.033	-.026	-.029
180.0	.096	.049	.004	-.031	-.204	-.184	-.123	-.050	-.039	-.031	-.028	-.020	-.023

SOC MACH=1.20 ALPHA=10.00 REL=4601250.

PHI \ Z/D=	.89	1.56	2.22	2.79	3.13	3.22	3.56	4.22	4.55	4.88	5.32	5.61	5.78
0.0	.326	.257	.186	.123	-.105	-.078	-.042	-.018	-.023	-.020	-.023	-.003	.007
22.5	.303	.237	.165	.102	-.112	-.103	-.060	-.038	-.045	-.042	-.039	-.021	-.011
45.0	.236	.165	.099	.042	-.157	0.000	-.116	-.095	0.000	-.088	-.095	-.064	-.054
67.5	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
90.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
112.5	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
135.0	.047	.004	-.023	-.038	-.243	0.000	-.166	-.070	0.000	-.063	-.061	-.050	-.056
157.5	.060	.019	-.020	-.052	-.212	-.203	-.133	-.063	-.044	-.053	-.058	-.054	-.060
180.0	.063	.025	-.012	-.044	-.217	-.191	-.121	-.041	-.034	-.024	-.027	-.012	-.011

TABLE 4. SOCBT PRESSURE COEFFICIENT DATA, $\alpha = 0°$

SOCBT

ALPHA=0 PHI=0

MACH \ Z/D=	.89	1.56	2.22	2.79	3.13	3.22	3.56	4.22	4.55	4.88	5.03	5.19	5.32	5.56	5.78
.91	.104	.019	-.050	-.120	-.391	-.361	.002	-.038	-.062	-.138	-.605	-.396	-.051	.005	.018
.94	.114	.027	-.044	-.106	-.404	-.380	-.246	-.012	-.039	-.102	-.550	-.476	-.325	.007	.046
.96	.122	.034	-.037	-.093	-.388	-.370	-.261	.027	.001	-.064	-.506	-.439	-.363	-.107	.044
.98	.134	.046	-.026	-.080	-.358	-.342	-.242	-.120	-.084	-.082	-.484	-.426	-.360	-.275	-.062
1.10	.172	.100	.038	-.005	-.217	-.212	-.142	-.072	-.046	-.036	-.341	-.293	-.246	-.190	-.144
1.20	.155	.097	.043	-.001	-.172	-.172	-.120	-.055	-.053	-.037	-.288	-.260	-.225	-.183	-.138

TABLE 5. SOCBT PRESSURE COEFFICIENT DATA, α = 2, 4, 6, and 10 DEGREES

a. M_∞ = 0.91

SOCBT MACH= .91 ALPHA= 2.00 REL=4488750.

PHI \ Z/D=	.89	1.56	2.22	2.79	3.13	3.22	3.56	4.22	4.55	4.88	5.03	5.19	5.32	5.56	5.78
0.0	.131	.044	-.030	-.104	-.401	-.349	-.009	-.036	-.057	-.128	-.597	-.472	-.074	.001	.013
22.5	.133	.044	-.029	-.103	-.400	-.351	-.009	-.036	-.058	-.127	-.600	-.481	-.074	-.002	.013
45.0	.127	.039	-.035	-.107	-.392	-.353	-.010	-.037	-.059	-.128	-.603	-.480	-.069	-.001	.015
67.5	.121	.033	-.040	-.112	-.392	-.357	-.006	-.040	-.061	-.133	-.604	-.458	-.063	.001	.013
90.0	.112	.026	-.045	-.116	-.396	-.364	0.000	-.040	-.065	-.136	-.609	-.424	-.061	.001	.014
112.5	.101	.017	-.053	-.122	-.395	-.368	.002	-.040	-.064	-.139	-.609	-.403	-.055	.003	.015
135.0	.094	.010	-.058	-.127	-.395	-.371	.001	-.040	-.064	-.141	-.610	-.364	-.048	.005	.019
157.5	.088	.004	-.064	-.132	-.395	-.367	.001	-.041	-.063	-.146	-.609	-.324	-.037	.010	.023
180.0	.083	0.000	-.067	-.134	-.394	-.372	.001	-.038	-.065	-.146	-.609	-.276	-.034	.014	.026

SOCBT MACH= .91 ALPHA= 4.00 REL=4488750.

PHI \ Z/D=	.89	1.56	2.22	2.79	3.13	3.22	3.56	4.22	4.55	4.88	5.03	5.19	5.32	5.56	5.78
0.0	.161	.071	-.007	-.085	-.402	-.337	-.017	-.032	-.054	-.117	-.595	-.487	-.101	-.010	.004
22.5	.159	.068	-.010	-.088	-.404	-.339	-.019	-.035	-.055	-.119	-.599	-.505	-.097	-.010	.004
45.0	.143	.053	-.023	-.099	-.403	-.350	-.024	-.040	-.062	-.126	-.605	-.509	-.090	-.011	.003
67.5	.123	.035	-.039	-.112	-.401	-.364	-.021	-.047	-.069	-.137	-.610	-.493	-.081	-.010	.001
90.0	.099	.012	-.059	-.129	-.414	-.379	-.027	-.051	-.074	-.145	-.615	-.453	-.066	-.007	.007
112.5	.081	-.002	-.070	-.139	-.407	-.384	-.016	-.050	-.073	-.151	-.613	-.358	-.050	.002	.015
135.0	.067	-.013	-.078	-.145	-.397	-.384	-.003	-.044	-.070	-.153	-.613	-.270	-.038	.011	.021
157.5	.064	-.016	-.080	-.146	-.392	-.373	.011	-.041	-.064	-.155	-.613	-.226	-.030	.018	.024
180.0	.059	-.020	-.083	-.149	-.390	-.373	.008	-.035	-.065	-.152	-.615	-.194	-.022	.018	.029

TABLE 5a. (CONTINUED)

SOCBT MACH= .91 ALPHA= 6.00 REL=4488750.

PHI	Z/D=.89	1.56	2.22	2.79	3.13	3.22	3.56	4.22	4.55	4.88	5.03	5.19	5.32	5.56	5.78
0.0	.192	.100	.018	-.065	-.393	-.315	-.023	-.027	-.045	-.106	-.586	-.493	-.144	-.014	-.003
22.5	.184	.091	.010	-.071	-.394	-.323	-.027	-.032	-.051	-.111	-.596	-.507	-.137	-.018	-.007
45.0	.157	.065	-.013	-.091	-.405	-.345	-.036	-.047	-.066	-.126	-.608	-.521	-.120	-.024	-.014
67.5	.116	.027	-.048	-.121	-.420	-.382	-.050	-.050	-.083	-.146	-.622	-.529	-.099	-.028	-.016
90.0	.083	-.004	-.076	-.147	-.486	-.409	-.062	-.072	-.091	-.165	-.628	-.460	-.073	-.021	-.009
112.5	.055	-.029	-.094	-.161	-.494	-.430	-.054	-.066	-.092	-.169	-.631	-.299	-.051	-.007	.006
135.0	.044	-.037	-.100	-.165	-.454	-.399	-.038	-.056	-.078	-.170	-.617	-.206	-.033	.010	.018
157.5	.039	-.039	-.098	-.162	-.399	-.388	-.003	-.041	-.069	-.162	-.614	-.148	-.018	.022	.028
180.0	.039	-.036	-.094	-.156	-.390	-.376	.014	-.031	-.061	-.158	-.614	-.134	-.014	.028	.033

SOCBT MACH= .91 ALPHA=10.00 REL=4488750.

PHI	Z/D=.89	1.56	2.22	2.79	3.13	3.22	3.56	4.22	4.55	4.88	5.03	5.19	5.32	5.56	5.78
0.0	.263	.164	.076	-.016	-.346	-.256	-.025	-.008	-.025	-.081	-.576	-.484	-.272	-.025	-.016
22.5	.240	.142	.055	-.035	-.357	-.278	-.039	-.023	-.042	-.093	-.594	-.494	-.287	-.036	-.027
45.0	.175	.077	-.006	-.091	-.401	-.336	-.080	-.068	-.082	-.139	-.622	-.530	-.210	-.057	-.052
67.5	.093	-.001	-.079	-.158	-.461	-.419	-.119	-.110	-.131	-.186	-.660	-.589	-.143	-.073	-.062
90.0	.023	-.066	-.134	-.202	-.497	-.470	-.133	-.128	-.151	-.215	-.678	-.443	-.093	-.053	-.041
112.5	-.013	-.094	-.145	-.214	-.555	-.445	-.112	-.111	-.133	-.217	-.674	-.211	-.061	-.020	-.016
135.0	-.012	-.088	-.136	-.199	-.537	-.299	-.071	-.076	-.099	-.215	-.521	-.143	-.049	-.006	-.005
157.5	-.003	-.077	-.123	-.179	-.504	-.276	-.040	-.054	-.085	-.199	-.511	-.119	-.041	-.002	.006
180.0	.003	-.064	-.104	-.167	-.491	-.305	-.025	-.033	-.063	-.172	-.620	-.079	-.020	.026	.030

TABLE 5b. $M_\infty = 0.94$

SOCBT MACH= .94 ALPHA= 2.00 REL=4545000.

PHI	Z/D=.89	1.56	2.22	2.79	3.13	3.22	3.56	4.22	4.55	4.88	5.03	5.19	5.32	5.56	5.78
0.0	.141	.051	-.024	-.089	-.394	-.381	-.238	-.010	-.037	-.092	-.546	-.478	-.383	-.006	.043
22.5	.143	.054	-.021	-.087	-.392	-.381	-.240	-.008	-.036	-.092	-.546	-.476	-.386	-.007	.042
45.0	.138	.049	-.025	-.090	-.394	-.382	-.242	-.010	-.036	-.092	-.546	-.478	-.387	-.007	.042
67.5	.131	.041	-.033	-.097	-.400	-.384	-.243	-.013	-.038	-.097	-.547	-.479	-.374	-.007	.043
90.0	.121	.032	-.040	-.103	-.409	-.387	-.245	-.014	-.041	-.101	-.551	-.481	-.352	0.000	.044
112.5	.110	.023	-.047	-.109	-.412	-.385	-.237	-.014	-.042	-.104	-.553	-.481	-.330	.008	.046
135.0	.103	.017	-.053	-.113	-.410	-.381	-.250	-.012	-.041	-.105	-.553	-.479	-.305	.012	.049
157.5	.098	.013	-.056	-.115	-.412	-.379	-.231	-.011	-.039	-.106	-.553	-.475	-.286	.015	.050
180.0	.094	.009	-.059	-.118	-.413	-.375	-.229	-.011	-.038	-.107	-.552	-.472	-.260	.018	.049

SOCBT MACH= .94 ALPHA= 4.00 REL=4545000.

PHI	Z/D=.89	1.56	2.22	2.79	3.13	3.22	3.56	4.22	4.55	4.88	5.03	5.19	5.32	5.56	5.78
0.0	.171	.079	.001	-.068	-.379	-.371	-.218	-.005	-.033	-.082	-.543	-.474	-.397	-.024	.037
22.5	.168	.075	-.002	-.072	-.382	-.371	-.221	-.008	-.031	-.083	-.542	-.472	-.398	-.033	.036
45.0	.152	.060	-.016	-.084	-.392	-.382	-.224	-.016	-.039	-.091	-.546	-.478	-.400	-.027	.034
67.5	.132	.042	-.033	-.098	-.402	-.395	-.247	-.020	-.048	-.100	-.551	-.487	-.400	-.016	.034
90.0	.110	.021	-.051	-.113	-.420	-.402	-.237	-.026	-.051	-.110	-.553	-.491	-.365	-.007	.036
112.5	.092	.006	-.064	-.124	-.424	-.396	-.231	-.023	-.052	-.114	-.555	-.491	-.303	.006	.043
135.0	.079	-.004	-.071	-.130	-.423	-.385	-.212	-.017	-.047	-.115	-.551	-.481	-.231	.017	.047
157.5	.073	-.009	-.074	-.132	-.419	-.378	-.190	-.011	-.041	-.115	-.557	-.472	-.186	.026	.051
180.0	.071	-.010	-.074	-.132	-.415	-.375	-.195	-.008	-.039	-.115	-.560	-.465	-.169	.032	.054

TABLE 5b. (CONTINUED)

SOCBT MACH= .94 ALPHA= 6.00 REL=4545000.

PHI \ Z/D=	.89	1.56	2.22	2.79	3.13	3.22	3.56	4.22	4.55	4.88	5.03	5.19	5.32	5.56	5.78
0.0	.204	.109	.026	-.047	-.363	-.353	-.202	-.002	-.025	-.071	-.536	-.465	-.394	-.072	.030
22.5	.195	.099	.018	-.055	-.370	-.358	-.201	-.008	-.030	-.075	-.539	-.469	-.397	-.065	.029
45.0	.165	.071	-.007	-.077	-.387	-.378	-.233	-.024	-.045	-.092	-.548	-.482	-.410	-.051	.022
67.5	.128	.036	-.040	-.106	-.409	-.406	-.266	-.037	-.062	-.111	-.564	-.498	-.425	-.034	.018
90.0	.092	.003	-.069	-.131	-.435	-.429	-.222	-.043	-.070	-.124	-.575	-.510	-.385	-.019	.023
112.5	.066	-.019	-.087	-.145	-.438	-.437	-.137	-.040	-.066	-.132	-.574	-.499	-.254	-.002	.032
135.0	.055	-.028	-.092	-.147	-.435	-.413	-.128	-.026	-.057	-.133	-.554	-.475	-.172	.016	.040
157.5	.050	-.030	-.090	-.145	-.429	-.388	-.089	-.012	-.044	-.125	-.559	-.454	-.125	.031	.052
180.0	.050	-.029	-.089	-.143	-.423	-.384	-.082	-.005	-.038	-.121	-.565	-.440	-.107	.041	.058

SOCBT MACH= .94 ALPHA=10.00 REL=4545000.

PHI \ Z/D=	.89	1.56	2.22	2.79	3.13	3.22	3.56	4.22	4.55	4.88	5.03	5.19	5.32	5.56	5.78
0.0	.272	.172	.083	0.000	-.322	-.299	-.143	.011	-.006	-.047	-.522	-.441	-.370	-.247	.022
22.5	.249	.149	.061	-.020	-.339	-.316	-.172	-.004	-.021	-.062	-.534	-.453	-.386	-.232	.014
45.0	.185	.087	.002	-.075	-.383	-.368	-.228	-.045	-.065	-.104	-.566	-.493	-.428	-.130	-.007
67.5	.103	.008	-.071	-.142	-.445	-.430	-.297	-.088	-.110	-.151	-.601	-.537	-.487	-.077	-.019
90.0	.035	-.056	-.125	-.187	-.468	-.475	-.223	-.107	-.129	-.181	-.619	-.574	-.340	-.047	-.008
112.5	0.000	-.084	-.136	-.199	-.486	-.490	-.124	-.086	-.113	-.182	-.624	-.477	-.168	-.022	.002
135.0	-.003	-.081	-.130	-.184	-.471	-.470	-.085	-.050	-.079	-.185	-.533	-.337	-.114	-.010	.012
157.5	.006	-.072	-.118	-.164	-.446	-.449	-.056	-.028	-.063	-.166	-.539	-.329	-.086	.003	.023
180.0	.013	-.059	-.098	-.152	-.447	-.435	-.032	-.005	-.039	-.139	-.589	-.316	-.049	.041	.053

TABLE 5c. $M_\infty = 0.96$

SOCBT MACH= .96 ALPHA= 2.00 REL=4578750.

PHI	Z/D=.89	1.56	2.22	2.79	3.13	3.22	3.56	4.22	4.55	4.88	5.03	5.19	5.32	5.56	5.78
0.0	.150	.060	-.015	-.076	-.377	-.360	-.252	.027	.003	-.056	-.501	-.437	-.367	-.192	.036
22.5	.150	.059	-.016	-.076	-.377	-.361	-.252	.027	.003	-.056	-.504	-.438	-.367	-.185	.036
45.0	.147	.057	-.018	-.078	-.378	-.363	-.253	.027	.002	-.057	-.505	-.438	-.368	-.175	.037
67.5	.139	.049	-.024	-.084	-.383	-.366	-.257	.026	.001	-.059	-.506	-.439	-.369	-.153	.038
90.0	.129	.040	-.033	-.091	-.387	-.370	-.261	.025	-.001	-.063	-.506	-.440	-.369	-.131	.040
112.5	.119	.032	-.040	-.096	-.390	-.374	-.263	.025	-.003	-.066	-.507	-.441	-.366	-.100	.044
135.0	.112	.025	-.045	-.101	-.392	-.374	-.266	.026	-.001	-.068	-.506	-.439	-.363	-.080	.048
157.5	.107	.020	-.049	-.103	-.392	-.374	-.267	.027	0.000	-.069	-.507	-.437	-.358	-.065	.049
180.0	.104	.018	-.051	-.105	-.391	-.372	-.268	.028	.001	-.070	-.506	-.436	-.354	-.057	.050

SOCBT MACH= .96 ALPHA= 4.00 REL=4578750.

PHI	Z/D=.89	1.56	2.22	2.79	3.13	3.22	3.56	4.22	4.55	4.88	5.03	5.19	5.32	5.56	5.78
0.0	.179	.086	.008	-.057	-.365	-.347	-.241	.025	.006	-.048	-.499	-.437	-.367	-.269	.023
22.5	.177	.084	.005	-.059	-.366	-.349	-.242	.022	.003	-.049	-.503	-.436	-.369	-.261	.023
45.0	.161	.069	-.007	-.070	-.375	-.358	-.254	.012	-.003	-.058	-.504	-.439	-.370	-.238	.023
67.5	.140	.049	-.026	-.086	-.387	-.372	-.270	.020	-.012	-.063	-.507	-.448	-.377	-.180	.028
90.0	.119	.030	-.043	-.101	-.397	-.383	-.278	.015	-.013	-.070	-.507	-.452	-.378	-.133	.034
112.5	.100	.013	-.057	-.112	-.404	-.385	-.287	.014	-.012	-.076	-.505	-.450	-.372	-.085	.042
135.0	.088	.003	-.064	-.117	-.405	-.382	-.285	.020	-.008	-.078	-.504	-.444	-.356	-.050	.050
157.5	.083	-.001	-.067	-.118	-.400	-.377	-.280	.027	-.003	-.077	-.505	-.436	-.340	-.031	.055
180.0	.081	-.002	-.067	-.118	-.396	-.373	-.278	.031	.002	-.076	-.508	-.431	-.332	-.021	.059

TABLE 5c. (CONTINUED)

SOCBT   MACH= .96   ALPHA= 6.00   REL=4578750.

PHI	Z/D=.89	1.56	2.22	2.79	3.13	3.22	3.56	4.22	4.55	4.88	5.03	5.19	5.32	5.56	5.78
0.0	.212	.115	.033	-.036	-.350	-.328	-.222	.028	.009	-.039	-.494	-.429	-.362	-.297	.004
22.5	.202	.106	.025	-.042	-.355	-.334	-.229	.024	.004	-.042	-.500	-.430	-.367	-.305	.007
45.0	.175	.081	.001	-.064	-.373	-.353	-.254	.002	-.012	-.061	-.504	-.444	-.377	-.292	.008
67.5	.137	.044	-.032	-.094	-.394	-.381	-.280	-.001	-.029	-.075	-.519	-.460	-.395	-.210	.011
90.0	.101	.011	-.062	-.118	-.415	-.402	-.299	-.013	-.035	-.091	-.529	-.472	-.395	-.129	.021
112.5	.075	-.011	-.080	-.128	-.419	-.408	-.293	-.007	-.032	-.097	-.531	-.458	-.368	-.068	.032
135.0	.063	-.020	-.086	-.134	-.418	-.401	-.286	.003	-.019	-.100	-.502	-.437	-.322	-.036	.039
157.5	.059	-.021	-.083	-.131	-.408	-.388	-.279	.017	-.007	-.094	-.501	-.426	-.287	-.013	.053
180.0	.059	-.021	-.082	-.128	-.401	-.383	-.284	.023	0.000	-.090	-.523	-.418	-.269	.002	.060

SOCBT   MACH= .96   ALPHA=10.00   REL=4578750.

PHI	Z/D=.89	1.56	2.22	2.79	3.13	3.22	3.56	4.22	4.55	4.88	5.03	5.19	5.32	5.56	5.78
0.0	.280	.179	.090	.012	-.313	-.282	-.172	.028	.025	-.017	-.485	-.406	-.339	-.298	-.135
22.5	.258	.157	.070	-.007	-.329	-.299	-.199	.024	.008	-.027	-.493	-.416	-.355	-.315	-.107
45.0	.193	.094	.010	-.063	-.377	-.348	-.250	-.017	-.032	-.075	-.523	-.456	-.393	-.366	-.047
67.5	.113	.017	-.062	-.124	-.419	-.411	-.305	-.059	-.079	-.122	-.558	-.498	-.444	-.285	-.028
90.0	.045	-.046	-.107	-.176	-.462	-.446	-.344	-.072	-.098	-.147	-.577	-.532	-.451	-.125	-.008
112.5	.010	-.076	-.133	-.189	-.475	-.459	-.339	-.057	-.079	-.150	-.583	-.476	-.287	-.061	-.001
135.0	.007	-.073	-.123	-.173	-.452	-.439	-.298	-.027	-.049	-.158	-.478	-.396	-.212	-.044	.009
157.5	.015	-.064	-.109	-.151	-.420	-.420	-.259	-.008	-.032	-.136	-.491	-.402	-.191	-.023	.023
180.0	.022	-.051	-.090	-.137	-.422	-.405	-.243	.016	-.006	-.106	-.544	-.382	-.162	.023	.058

TABLE 5d. $M_\infty = 0.98$

SOCBT MACH= .98 ALPHA= 2.00 REL=4601250.

PHI \ Z/D=	.89	1.56	2.22	2.79	3.13	3.22	3.56	4.22	4.55	4.88	5.03	5.19	5.32	5.56	5.78
0.0	.161	.069	-.005	-.062	-.348	-.333	-.233	-.125	-.089	-.076	-.481	-.429	-.364	-.295	-.135
22.5	.162	.070	-.005	-.062	-.348	-.332	-.233	-.126	-.088	-.077	-.481	-.425	-.364	-.294	-.116
45.0	.157	.067	-.008	-.066	-.352	-.334	-.235	-.127	-.089	-.077	-.484	-.425	-.365	-.294	-.117
67.5	.150	.059	-.014	-.071	-.356	-.339	-.239	-.128	-.091	-.079	-.484	-.424	-.366	-.291	-.108
90.0	.140	.051	-.022	-.077	-.359	-.343	-.243	-.126	-.091	-.080	-.483	-.425	-.365	-.286	-.096
112.5	.132	.043	-.028	-.083	-.360	-.345	-.246	-.123	-.089	-.082	-.482	-.424	-.364	-.276	-.072
135.0	.124	.036	-.035	-.088	-.362	-.345	-.246	-.117	-.086	-.085	-.483	-.424	-.361	-.265	-.058
157.5	.118	.031	-.039	-.091	-.363	-.345	-.247	-.112	-.083	-.086	-.484	-.422	-.357	-.256	-.028
180.0	.117	.030	-.039	-.092	-.361	-.345	-.245	-.107	-.082	-.086	-.484	-.422	-.354	-.244	-.047

SOCBT MACH= .98 ALPHA= 4.00 REL=4601250.

PHI \ Z/D=	.89	1.56	2.22	2.79	3.13	3.22	3.56	4.22	4.55	4.88	5.03	5.19	5.32	5.56	5.78
0.0	.191	.097	.018	-.044	-.335	-.319	-.223	-.121	-.094	-.074	-.478	-.429	-.368	-.307	-.195
22.5	.188	.095	.017	-.045	-.335	-.321	-.223	-.122	-.092	-.077	-.484	-.427	-.369	-.309	-.215
45.0	.173	.081	.004	-.056	-.346	-.328	-.233	-.125	-.101	-.085	-.483	-.428	-.369	-.311	-.177
67.5	.153	.061	-.014	-.072	-.358	-.343	-.250	-.137	-.105	-.082	-.485	-.435	-.374	-.306	-.160
90.0	.130	.040	-.033	-.088	-.371	-.352	-.259	-.134	-.104	-.088	-.482	-.434	-.375	-.297	-.093
112.5	.112	.025	-.046	-.099	-.375	-.358	-.264	-.125	-.097	-.093	-.482	-.433	-.368	-.268	-.058
135.0	.101	.015	-.053	-.105	-.375	-.354	-.265	-.107	-.089	-.094	-.481	-.427	-.358	-.239	-.018
157.5	.095	.010	-.056	-.106	-.371	-.349	-.257	-.091	-.081	-.093	-.482	-.422	-.348	-.207	-.001
180.0	.093	.009	-.056	-.106	-.367	-.346	-.255	-.082	-.076	-.092	-.485	-.419	-.343	-.192	-.009

TABLE 5d. (CONTINUED)

SOCBT MACH= .98 ALPHA= 6.00 REL=4601250.

PHI	Z/D=.89	1.56	2.22	2.79	3.13	3.22	3.56	4.22	4.55	4.88	5.03	5.19	5.32	5.56	5.78
0.0	.223	.127	.044	-.021	-.320	-.302	-.205	-.116	-.094	-.071	-.479	-.428	-.363	-.313	-.263
22.5	.215	.119	.037	-.027	-.325	-.307	-.212	-.117	-.095	-.072	-.482	-.424	-.368	-.318	-.264
45.0	.188	.093	.013	-.049	-.344	-.324	-.236	-.135	-.114	-.092	-.483	-.431	-.379	-.330	-.226
67.5	.149	.056	-.020	-.080	-.367	-.353	-.261	-.149	-.125	-.099	-.499	-.450	-.394	-.327	-.187
90.0	.113	.023	-.051	-.105	-.389	-.372	-.280	-.155	-.124	-.111	-.505	-.459	-.395	-.305	-.064
112.5	.088	.001	-.068	-.115	-.394	-.380	-.272	-.139	-.115	-.115	-.509	-.442	-.374	-.219	-.040
135.0	.075	-.008	-.074	-.122	-.389	-.371	-.264	-.117	-.098	-.120	-.480	-.421	-.352	-.189	-.016
157.5	.071	-.010	-.073	-.121	-.380	-.360	-.258	-.098	-.082	-.111	-.478	-.414	-.330	-.157	.003
180.0	.072	-.008	-.070	-.117	-.370	-.355	-.260	-.091	-.073	-.109	-.502	-.408	-.315	-.141	.006

SOCBT MACH= .98 ALPHA=10.00 REL=4601250.

PHI	Z/D=.89	1.56	2.22	2.79	3.13	3.22	3.56	4.22	4.55	4.88	5.03	5.19	5.32	5.56	5.78
0.0	.294	.192	.103	.029	-.284	-.257	-.160	-.102	-.099	-.061	-.468	-.414	-.349	-.309	-.282
22.5	.270	.169	.082	.010	-.301	-.274	-.187	-.122	-.104	-.069	-.479	-.417	-.366	-.324	-.301
45.0	.206	.107	.023	-.046	-.347	-.323	-.235	-.168	-.147	-.113	-.504	-.453	-.398	-.368	-.322
67.5	.126	.029	-.049	-.108	-.396	-.385	-.293	-.213	-.183	-.153	-.538	-.490	-.445	-.408	-.173
90.0	.058	-.034	-.097	-.161	-.439	-.419	-.333	-.219	-.189	-.168	-.554	-.518	-.464	-.238	-.083
112.5	.022	-.064	-.120	-.176	-.450	-.433	-.326	-.184	-.158	-.168	-.555	-.472	-.369	-.160	-.055
135.0	.020	-.061	-.111	-.160	-.426	-.411	-.288	-.136	-.117	-.174	-.461	-.408	-.315	-.139	-.051
157.5	.028	-.052	-.099	-.138	-.391	-.388	-.255	-.110	-.097	-.155	-.474	-.407	-.302	-.133	-.026
180.0	.035	-.040	-.079	-.125	-.394	-.376	-.239	-.085	-.072	-.124	-.522	-.384	-.282	-.089	.020

TABLE 5e. $M_\infty = 1.10$

SOCBT MACH=1.10 ALPHA= 2.00 REL=4713750.

PHI	Z/D=.89	1.56	2.22	2.79	3.13	3.22	3.56	4.22	4.55	4.88	5.03	5.19	5.32	5.56	5.78
0.0	.198	.125	.055	.014	-.204	-.200	-.136	-.071	-.068	-.035	-.343	-.308	-.254	-.199	-.158
22.5	.198	.125	.056	.015	-.203	-.201	-.137	-.071	-.068	-.035	-.347	-.301	-.245	-.198	-.154
45.0	.195	.121	.053	.012	-.204	-.203	-.139	-.073	-.069	-.046	-.338	-.289	-.242	-.194	-.150
67.5	.188	.113	.047	.007	-.207	-.205	-.144	-.075	-.072	-.052	-.338	-.284	-.239	-.190	-.146
90.0	.179	.105	.039	0.000	-.213	-.209	-.149	-.077	-.072	-.052	-.337	-.283	-.234	-.186	-.142
112.5	.169	.098	.034	-.005	-.218	-.213	-.153	-.077	-.071	-.044	-.337	-.282	-.232	-.183	-.135
135.0	.162	.090	.027	-.011	-.219	-.217	-.151	-.077	-.066	-.044	-.331	-.282	-.235	-.179	-.129
157.5	.157	.087	.023	-.013	-.221	-.217	-.151	-.074	-.062	-.038	-.339	-.286	-.238	-.177	-.123
180.0	.153	.085	.023	-.015	-.226	-.218	-.151	-.070	-.055	-.033	-.342	-.293	-.240	-.178	-.120

SOCBT MACH=1.10 ALPHA= 4.00 REL=4713750.

PHI	Z/D=.89	1.56	2.22	2.79	3.13	3.22	3.56	4.22	4.55	4.88	5.03	5.19	5.32	5.56	5.78
0.0	.228	.150	.079	.034	-.189	-.187	-.126	-.069	-.067	-.044	-.339	-.319	-.252	-.202	-.168
22.5	.225	.146	.075	.032	-.190	-.189	-.127	-.072	-.066	-.047	-.349	-.306	-.246	-.202	-.167
45.0	.210	.133	.065	.021	-.198	-.196	-.142	-.079	-.070	-.055	-.350	-.302	-.244	-.202	-.168
67.5	.190	.114	.049	.005	-.211	-.209	-.153	-.090	-.080	-.057	-.342	-.297	-.251	-.201	-.162
90.0	.168	.094	.032	-.013	-.223	-.221	-.161	-.086	-.084	-.048	-.333	-.297	-.252	-.196	-.152
112.5	.151	.079	.021	-.024	-.230	-.227	-.164	-.085	-.078	-.042	-.328	-.291	-.248	-.188	-.136
135.0	.140	.069	.013	-.030	-.233	-.228	-.164	-.074	-.065	-.032	-.329	-.286	-.241	-.179	-.118
157.5	.134	.066	.010	-.032	-.233	-.225	-.157	-.071	-.043	-.030	-.332	-.284	-.235	-.170	-.107
180.0	.131	.064	.009	-.032	-.233	-.223	-.152	-.068	-.025	-.030	-.340	-.291	-.235	-.163	-.103

TABLE 5e. (CONTINUED)

SOCBT MACH=1.10 ALPHA= 6.00 REL=4713750.

PHI	Z/D=.89	1.56	2.22	2.79	3.13	3.22	3.56	4.22	4.55	4.88	5.03	5.19	5.32	5.56	5.78
0.0	.261	.180	.107	.053	-.172	-.171	-.108	-.064	-.060	-.038	-.325	-.311	-.264	-.215	-.177
22.5	.250	.170	.099	.047	-.178	-.175	-.116	-.070	-.065	-.043	-.345	-.309	-.255	-.220	-.179
45.0	.223	.143	.076	.025	-.196	-.194	-.142	-.094	-.080	-.049	-.344	-.301	-.265	-.230	-.185
67.5	.188	.110	.046	-.003	-.218	-.221	-.164	-.100	-.094	-.060	-.345	-.313	-.277	-.237	-.184
90.0	.152	.077	.017	-.027	-.235	-.235	-.180	-.108	-.090	-.058	-.352	-.320	-.277	-.224	-.164
112.5	.129	.057	.001	-.039	-.244	-.243	-.178	-.099	-.078	-.057	-.351	-.305	-.256	-.195	-.139
135.0	.116	.047	-.006	-.044	-.244	-.242	-.169	-.073	-.062	-.057	-.327	-.281	-.238	-.171	-.119
157.5	.112	.047	-.005	-.045	-.234	-.234	-.158	-.054	-.045	-.051	-.326	-.276	-.221	-.153	-.104
180.0	.112	.048	-.003	-.045	-.236	-.229	-.157	-.043	-.035	-.043	-.351	-.277	-.212	-.143	-.094

SOCBT MACH=1.10 ALPHA=10.00 REL=4713750.

PHI	Z/D=.89	1.56	2.22	2.79	3.13	3.22	3.56	4.22	4.55	4.88	5.03	5.19	5.32	5.56	5.78
0.0	.331	.247	.166	.102	-.136	-.132	-.071	-.037	-.041	-.023	-.324	-.300	-.249	-.222	-.198
22.5	.308	.223	.144	.082	-.152	-.148	-.094	-.061	-.052	-.037	-.341	-.298	-.258	-.231	-.210
45.0	.244	.163	.087	.028	-.197	-.194	-.146	-.109	-.103	-.070	-.362	-.325	-.288	-.265	-.251
67.5	.167	.089	.018	-.038	-.250	-.253	-.205	-.152	-.146	-.102	-.382	-.354	-.322	-.305	-.263
90.0	.101	.030	-.032	-.081	-.289	-.289	-.231	-.170	-.156	-.099	-.391	-.373	-.338	-.273	-.211
112.5	.066	-.002	-.052	-.099	-.297	-.292	-.226	-.141	-.116	-.086	-.391	-.329	-.269	-.199	-.157
135.0	.061	.003	-.045	-.086	-.269	-.268	-.190	-.090	-.072	-.090	-.313	-.278	-.234	-.168	-.133
157.5	.070	.012	-.029	-.065	-.240	-.244	-.159	-.064	-.051	-.069	-.337	-.280	-.222	-.157	-.115
180.0	.076	.021	-.021	-.055	-.253	-.231	-.143	-.038	-.027	-.042	-.362	-.278	-.202	-.127	-.084

TABLE 5f. $M_\infty = 1.20$

SOCBT MACH=1.20 ALPHA= 2.00 REL=4612500.

PHI	Z/D=.89	1.56	2.22	2.79	3.13	3.22	3.56	4.22	4.55	4.88	5.03	5.19	5.32	5.56	5.78
0.0	.180	.118	.061	.017	-.159	-.162	-.113	-.056	-.052	-.037	-.277	-.262	-.229	-.191	-.154
22.5	.181	.119	.062	.017	-.158	-.162	-.113	-.054	-.051	-.037	-.285	-.263	-.229	-.191	-.154
45.0	.177	.115	.058	.013	-.161	-.164	-.116	-.057	-.049	-.038	-.290	-.264	-.229	-.190	-.150
67.5	.168	.109	.052	.009	-.165	-.167	-.121	-.060	-.051	-.040	-.289	-.265	-.228	-.188	-.148
90.0	.158	.101	.044	.003	-.170	-.172	-.126	-.060	-.053	-.040	-.289	-.264	-.226	-.185	-.142
112.5	.150	.093	.038	-.003	-.175	-.176	-.129	-.060	-.053	-.039	-.287	-.261	-.224	-.180	-.137
135.0	.142	.086	.032	-.007	-.179	-.177	-.128	-.059	-.052	-.037	-.286	-.259	-.221	-.175	-.128
157.5	.138	.082	.029	-.010	-.179	-.179	-.129	-.057	-.049	-.035	-.286	-.256	-.217	-.170	-.123
180.0	.134	.079	.026	-.012	-.181	-.178	-.129	-.055	-.047	-.034	-.284	-.253	-.215	-.167	-.117

SOCBT MACH=1.20 ALPHA= 4.00 REL=4612500.

PHI	Z/D=.89	1.56	2.22	2.79	3.13	3.22	3.56	4.22	4.55	4.88	5.03	5.19	5.32	5.56	5.78
0.0	.211	.145	.084	.037	-.143	-.147	-.102	-.053	-.052	-.035	-.266	-.262	-.226	-.199	-.167
22.5	.207	.143	.082	.035	-.145	-.150	-.104	-.054	-.051	-.034	-.284	-.261	-.228	-.199	-.168
45.0	.191	.127	.068	.023	-.153	-.158	-.115	-.060	-.053	-.041	-.287	-.265	-.233	-.202	-.167
67.5	.173	.109	.052	.008	-.166	-.169	-.127	-.072	-.060	-.044	-.291	-.269	-.237	-.202	-.162
90.0	.151	.090	.036	-.007	-.177	-.179	-.134	-.067	-.065	-.048	-.291	-.270	-.236	-.193	-.153
112.5	.134	.074	.023	-.019	-.181	-.184	-.135	-.069	-.061	-.046	-.290	-.265	-.227	-.183	-.138
135.0	.123	.064	.016	-.023	-.187	-.186	-.133	-.064	-.055	-.040	-.281	-.253	-.216	-.171	-.120
157.5	.118	.060	.013	-.025	-.187	-.183	-.133	-.055	-.045	-.031	-.279	-.248	-.210	-.159	-.107
180.0	.116	.059	.013	-.025	-.186	-.180	-.130	-.048	-.035	-.027	-.280	-.251	-.206	-.151	-.099

TABLE 5f. (CONTINUED)

SOCBT MACH=1.20 ALPHA= 6.00 REL=4612500.

PHI \ Z/D=	.89	1.56	2.22	2.79	3.13	3.22	3.56	4.22	4.55	4.88	5.03	5.19	5.32	5.56	5.78
0.0	.243	.173	.111	.059	-.125	-.131	-.086	-.046	-.048	-.030	-.270	-.260	-.228	-.205	-.177
22.5	.235	.165	.104	.053	-.130	-.135	-.093	-.050	-.048	-.034	-.283	-.263	-.232	-.207	-.180
45.0	.207	.139	.080	.031	-.148	-.152	-.114	-.073	-.062	-.046	-.294	-.272	-.244	-.217	-.188
67.5	.170	.105	.048	.004	-.170	-.177	-.137	-.083	-.079	-.060	-.302	-.282	-.255	-.225	-.187
90.0	.135	.075	.020	-.017	-.184	-.191	-.150	-.090	-.084	-.065	-.308	-.289	-.259	-.215	-.170
112.5	.111	.054	.008	-.031	-.193	-.199	-.151	-.085	-.075	-.060	-.305	-.278	-.238	-.189	-.139
135.0	.099	.045	.002	-.034	-.194	-.197	-.141	-.069	-.059	-.054	-.287	-.252	-.216	-.163	-.116
157.5	.095	.044	-.002	-.031	-.191	-.188	-.132	-.055	-.045	-.044	-.277	-.243	-.201	-.146	-.100
180.0	.095	.044	-.002	-.032	-.190	-.189	-.127	-.045	-.037	-.035	-.285	-.240	-.191	-.136	-.089

SOCBT MACH=1.20 ALPHA=10.00 REL=4612500.

PHI \ Z/D=	.89	1.56	2.22	2.79	3.13	3.22	3.56	4.22	4.55	4.88	5.03	5.19	5.32	5.56	5.78
0.0	.315	.243	.170	.115	-.081	-.088	-.046	-.017	-.028	-.017	-.265	-.256	-.226	-.208	-.184
22.5	.294	.222	.149	.097	-.097	-.103	-.067	-.042	-.039	-.033	-.282	-.266	-.243	-.220	-.202
45.0	.232	.162	.094	.043	-.141	-.148	-.116	-.091	-.087	-.077	-.315	-.300	-.276	-.253	-.240
67.5	.154	.089	.026	-.021	-.192	-.201	-.172	-.136	-.135	-.117	-.346	-.331	-.308	-.292	-.269
90.0	.087	.026	-.025	-.068	-.234	-.238	-.209	-.163	-.152	-.127	-.352	-.341	-.319	-.276	-.211
112.5	.052	-.001	-.046	-.086	-.241	-.249	-.206	-.136	-.119	-.100	-.343	-.303	-.255	-.197	-.152
135.0	.047	.003	-.038	-.073	-.227	-.228	-.170	-.089	-.075	-.088	-.280	-.252	-.219	-.165	-.129
157.5	.056	.009	-.020	-.053	-.203	-.204	-.139	-.063	-.055	-.067	-.298	-.247	-.211	-.154	-.114
180.0	.060	.018	-.015	-.042	-.206	-.193	-.123	-.040	-.033	-.037	-.294	-.258	-.188	-.121	-.085

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LIST OF SYMBOLS

$A_{m,n}$	incremental surface area of model at m,n location
C_A	axial force coefficient, excluding base drag
$C_{A_{m,n}}$	increment of C_A associated with a local pressure and local surface area
C_m	pitching moment coefficient, $m/q_\infty SD$
C_{m_α}	slope of the pitching moment coefficient curve at $\alpha = 0$
C_N	normal force coefficient, $F_N/q_\infty S$
$C_{N_{m,n}}$	increment of C_N associated with a local pressure and local surface area
C_{N_α}	slope of the normal force coefficient curve at $\alpha = 0$
C_p	pressure coefficient, $(P_\ell - P_\infty)/q_\infty$
D	model diameter at the cylindrical section
M_∞	free-stream Mach number
P_ℓ	local surface pressure on the model
P_o	wind tunnel supply pressure
P_∞	free-stream static pressure
q_∞	free-stream dynamic pressure
r	local model radius
Re_ℓ	Reynolds number based on model length
S	reference area, $\pi D^2/4$
SOC	Secant-Ogive-Cylinder Model
SOCBT	Secant-Ogive-Cylinder Model with 7 degree boattail (Figure 1)
T_o	wind tunnel supply temperature
Z_{cg}	axial position of the center of gravity, $Z_{cg}/D = 3.6$
Z_n	axial position on model defined by index <u>n</u>
Z/D	distance from model nose in calibers
α	angle of attack, degrees

LIST OF SYMBOLS (cont'd)

θ local angle between model centerline and tangent to model surface

ϕ circumferential position of pressure taps

Subscripts

m index indicating circumferential psoition on model, $1 \leq m \leq 32$, or 11.25 deg increments

n index indicating longitudinal position on model, $1 \leq n \leq 120$, .05 caliber increments

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